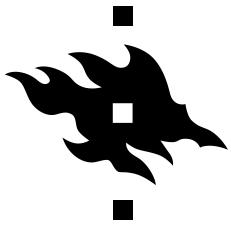

HELSINGIN YLIOPISTO

Future pathways for the emerging bioeconomy: case of the fiber-based packaging sector in Finland

Faculty of Agriculture and Forestry

For the examination of Master of Science in

Forest Economics and Marketing

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Tiivistelmä — Referat — Abstract

There is a growing interest towards the concept of bioeconomy both in research and politics. Recent policy documents include an emerging number of national bioeconomy strategies and some international organizations' bioeconomy strategies such as the European Union's and the OECD's strategies. So far, the research about bioeconomy has focused mainly on studying the emphasis of different bioeconomy strategies. However, there seems to be a lack of research about the social aspects of the bioeconomy.

For the successful implementation of the bioeconomy strategies different stakeholder groups need to accept the concept and have similar visions for its development in the future. To address these issues, it is necessary to know about the understandings that different actors have about the concept and how the emerging bioeconomy is going to influence on their actions. To assess the understanding and perception about the concept of bioeconomy in the fiber-based packaging sector, this research carried out a literature review and qualitative analysis of 14 thematic interviews among the actor network members. As this can be considered a pioneering research, a broad sectoral level focus was chosen. Thus, different actors were selected for the study to cover a broad range of stakeholder groups. However, an industry focus was justified to enable sufficient understanding of future pathways in business side of the sector. Other stakeholder groups that were interviewed include research, government and NGO groups in Finland.

According to the results, the concept of bioeconomy was understood similarly across the stakeholder groups. The economic motives were often mentioned of being important drivers, but issues regarding the sustainability were also found to be crucial. After deepening analysis of more specific subjects, the understandings and the opinions started to diverge among the interviewees. While the bioeconomy concept could be considered familiar to all of the stakeholders within the fiber-based packaging sector it can be argued that further defining is needed for its future evolution.

Greatest differences in the level of acceptance and attitudes were found within the industry stakeholders, and between the industry group and other stakeholder groups. The industry representatives' opinions varied broadly from very optimistic views about the future of bioeconomy to extreme skepticism and frustration about the initiatives concerning the bioeconomy. Many of them defined it as a new marketing term, but sustainability in operations was also considered as an important competitive factor in the future. Other stakeholders shared a positive view about the bioeconomy of helping in bridging different sectors together.

The study found that although every stakeholder group was considered to be important for the future development of the concept, the brand owners carry the most potential to influence for the future development. Thus, future studies, for example about brand owners' views about the bioeconomy are needed. Study's orientation towards operative actors can be considered as a limiting factor as it weakens its reliability as a comprehensive review. Additionally, in some cases the interviews can be considered superficial as the discussion did not manage to go beyond interviewees' own agendas and own interests were protected.

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The bioeconomy, acceptance, fiber-based packaging, sustainability

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Tiivistelmä — Referat — Abstract

Tieteen- ja politiikanaloilla on viime vuosina esiintynyt kasvavissa määrin mielenkiintoa biotaloustermiä kohtaan. Viime aikoina julkaistuihin poliittisiin dokumentteihin kuuluvat eri valtioiden ja kansainvälisten organisaatioiden kuten Euroopan unionin ja OECD:n biotalousstrategiat. Tähänastinen aiheeseen liittyvä tutkimus on keskittynyt lähinnä eri biotalousstrategioiden sisältöjen tutkimiseen. Lisäksi biotalouden määritelmään ja tulevaisuuteen liittyviä tutkimuksia erityisesti teknologisestä näkökulmasta on tehty jonkin verran. Tutkimuksia biotalouden sosiaalisesta puolesta, kuten sen eri sidosryhmien näkemyksistä biotalouden kehittymiseen ei sen sijaan ole juurikaan tehty.

Biotalousstrategioiden onnistuneen toteutuksen varmistamiseksi on tärkeää, että eri sidosryhmät hyväksyvät biotalouskonseptin ja jakavat samansuuntaiset visiot sen tulevaisuudesta. Näin ollen on tärkeää ymmärtää miten eri toimijat käsittävät konseptin ja kuinka se mahdollisesti vaikuttaa heidän tuleviin toimiinsa. Tämä tutkimus auttaa hahmottamaan miten biotalouskonsepti ymmärretään Suomen kuitupohjaisella pakkaussektorilla ja millaisena eri sidosryhmät näkevät tulevaisuuden kehityksen. Tutkimus perustuu kirjallisuuskatsaukseen sekä laadulliseen analyysiin, jota varten on haastateltu 14:ää biotalouden asiantuntijaa. Tutkimus on ensimmäisiä laatuaan, joten sidosryhmät valittiin tarkoituksena kattaa sektori laajasti. Painotus asetettiin kuitenkin teollisuuden edustajille, jotta riittävä ymmärrys tulevaisuuden kehityspoluista liiketoiminnan näkökulmasta olisi mahdollista saavuttaa. Muita sidosryhmiä tutkimuksessa edustivat tutkimus, julkinen hallinto ja kansalaisjärjestöt.

Tulokset osoittavat, että, sidosryhmien ymmärrys biotalouskonseptista oli samantapainen. Konseptin taloudelliset motiivit tunnistettiin tärkeäksi tekijäksi, vaikka myös ympäristöön liittyviä kestävyystekijöitä nostettiin laajasti esille. Keskityttäessä tarkemmin joihinkin aiheisiin, haastateltavien mielipiteet alkoivat erota toisistaan. Suurimmat erot hyväksyttävyydessä ja asenteissa löytyivät teollisuuden edustajien ryhmän sekä sen ja muiden sidosryhmien välillä. Teollisuuden edustajien näkemykset ulottuivat optimistisista näkemyksistä erittäin skeptisiin ja turhautuneisiin näkemyksiin biotaloudesta ja sitä kuvailtiinkin usein markkinointiterminä. Kuitenkin eri kestävyystekijöiden huomioiminen koettiin tulevaisuuden kilpailukykyä parantavana tekijänä. Muut sidosryhmät jakoivat positiivisen näkemyksen biotaloudesta sektoreita yhdistävänä konseptina.

Tutkimus osoitti, että kaikki sidosryhmät on huomioitava biotalouskonseptin tulevaisuuden kehityksessä. Brändien omistajat koettiin kaikkein potentiaalisimmiksi muutoksen synnyttäjiksi, mutta heidän näkemykset puuttuivat tästä tutkimuksesta. Tutkimus keskittyi biotalouden operatiivisiin toimijoihin, jota voidaan pitää toisena tutkimusta rajoittavana tekijänä, koska se heikentää tutkimuksen luotettavuutta strategisesta näkökulmasta. Lisäksi osassa haastatteluissa ei päästy haastateltavan omien tarkoitusperien yli vaan haastattelut jäivät siltä osin pinnallisiksi, haastateltavien omia asemiaan suojeleviksi.

Avainsanat — Nyckelord — Keywords
Biotalous, hyväksyttävyys, kuitupohjainen pakkaaminen, kestävyys

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1 Introduction

1.1 Background

The concept of bioeconomy has become increasingly popular in policy and scientific literature and despite the growing importance of the concept, its meaning is still developing (Bugge et al. 2016; Pülzl et al. 2014; Pfau et al. 2014). Several national and international strategies have been made that stress the importance of the concept of bioeconomy highlighting its future potential (see e.g. European Commission, 2012; OECD, 2014). Besides bioeconomy's physical advantages, it already is one of the biggest sectors in Europe with an annual turnover of around 2 trillion euros and employing around 22 million people covering agriculture, forestry, fisheries, food and chemicals (European Commission, 2012). Both the European Union's bioeconomy strategy and various national strategies emphasize the role of the bioeconomy in replacing the current economy, which is highly dependable on non-renewable resources such as oil, coal and minerals. According to Bunger's (2010) assumptions, bio-based products could in future replace 90 % of oil-based alternatives.

The bioeconomy strategies often have common, ambitious goals and the positive impacts from a developed bioeconomy seem vast (McCormick et al. 2013). On the other hand, according to the majority of experts in earlier studies, the bioeconomy will potentially increase sustainability only if certain set of criteria is met. For example, the opinion that sustainability will implicitly follow the bioeconomy would further enforce the excessive consumption of resources and hold back development (Priefer et al. 2017).

As a concept, the bioeconomy is multi-sectoral and thus covers various industries. Pfau et al. (2014) claim that to be successful, all the stakeholders within the bioeconomy need to be heard in the discussions. Hagemann et al. (2015) additionally conclude that while politics have an important role in fostering the bioeconomy, also consumers' and producers' acceptance is required for the bioeconomy to develop. With the high ambition level that is set for the bioeconomy, it is highly important to understand what perceptions the different stakeholders have about the concept and what it stands for.

Forest sector is part of the whole of bioeconomy and it is an important provider of biomass within the bioeconomy. Forests contain some unique features that include its high biomass yield, which does not threaten food production (Ollikainen 2014, Roos and Stendal 2016). Forests also have a high potential in carbon sequestration, which is important for lowering the amount of carbon dioxide in the atmosphere. In Finland, forests have an important societal and cultural role. Furthermore, forest industry was the largest exporter in terms of value in 2015 from all industries (Finnish Customs, 2015). Therefore, it is particularly important to understand how different actors in the forest industry perceive the concept of bioeconomy within development of the forest-based bioeconomy (see also Korhonen et al. 2017, Toppinen et al. 2017).

With a market share of 35%, the most used packaging material is packaging paper and paperboard (Hetemäki & Hurmekoski, 2014). The competition against its toughest alternative, plastics, will have a high influence on the development of its future demand. Different features of the bioeconomy and the technological development enable high potential for the future of the bio-based packaging, making it an interesting forest industry sector when trying to understand future pathways of the bioeconomy. As the overall use of packaging materials is growing globally, the packaging sector plays a key role in developing an efficient circular bioeconomy (Hetemäki et al. 2017).

However, discussion about the fiber-based packaging should be critical and its sustainability should not be taken for granted. One issue, which is under debate concerns the use of disposable packages. For example, in Great Britain, there is an ongoing governmental discussion about the recycling of disposable coffee cups. Since the demand for disposable cups is growingly significant and their recycling has shown to be a challenging issue, they have proved to be a real sustainability issue. Thus, a British parliamentary committee issued a report, which recommends a 25 pence tax for every disposable cup sold (The UK House of Commons Environmental Audit Committee in 2017). The tax has been referred to as "latte levy".

From an economic perspective, packaging is usually assessed by comparing sales statistics with different packages and considering if the manufacturing costs have decreased. In a study by Garcia-Arca et al. (2017) they present a list of packaging features that are studied to have an increasing effect on companies' sales. The list includes e.g. packaging's possibility in promoting differentiation and subsequent sales

and packaging in highlighting product's green image. Additionally, packaging can reduce costs by improving efficiency of a product in logistic and productive level. Here, also reduction of waste and waste management is considerable.

With the increasing body of scientific literature about the bioeconomy, various approaches to study the concept have emerged. Former literature include studies about origins and uptake of the concept (see. Bugge et al. 2016), as well as studies that are focused in different national strategies and policies concerning about the concept (see Staffas et al. 2013). Future visions for the bioeconomy are additionally under the scope in studies by e.g. Pfau et al. (2014) and Bugge et al. (2016). Several scientific articles additionally describe the meaning and understanding of the concept trough literature reviews (see Staffas et al. 2013) and some study the concept by examining different sectors in the bioeconomy (Scarlat et al. 2015). Pülzl et al (2014) study the bioeconomy as a discourse in the forest sector and compare it to other global meta-discourses.

Although recent studies about the concept of bioeconomy exist, only a few, if even that, study the subject from a social perspective on a stakeholder level. Hodge (2016) studied the concept in Sweden by interviewing several forest sector stakeholders about their perceptions about it while Giurca and Späth (2017) analysed it in case of biorefinery development in Germany. More studies from different countries are needed, especially at business and product levels, to able a more comprehensive view of stakeholder perception and enable a comparison between countries and between different stakeholders. This would give a better understanding about the true potential of the bioeconomy to contribute for future economic and environmental sustainability.

1.2 Aim of the study

This thesis studies how different stakeholders in Finnish fiber-based packaging business perceive the sector's role in a transition toward the bioeconomy. The aim is twofold. Firstly, the aim is to offer information how industrial actors, experts and other stakeholders understand the emerging concept of the bioeconomy. Secondly, the

research attempts to identify what the future development will look like according to the different stakeholders. The research questions are presented as:

R1: How do the actors in the fiber-based packaging sector understand the concept of the bioeconomy?

R2: Which of the possible evolution pathways suggested by Priefer et al. (2017) the future development of the fiber-based packaging sector is likely to follow?

2 Defining the bioeconomy

2.1 Bioeconomy policies

The World Commission on Environmental Development's (1987) definition of sustainable development is as follows *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. According to Schaltegger (2016, p. 265) this definition has become accepted worldwide. The bioeconomy has been considered part of the sustainable development, while some concerns about its contribution to improve a holistic sustainability have been also voiced (See e.g. D'Amato et al. 2017, Meyer 2017).

The European Union define the bioeconomy as follows: *"Bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products*[1] *and bioenergy. It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries"* (European Commission, 2012, p. 16) (See figure 2.1). Several studies have been made that notice the increasing use of the concept of bioeconomy both in policy papers and in scientific literature (Bugge. et al. 2016; Pülzl et al. 2014; Pfau et al. 2014). For instance, the concept often occurs in various countries' and international organizations' environmental strategies such as in the European Union's and OECD's policy papers.

[1] Bio-based products are products that are wholly or partly bio-based (CEN – Report on Mandate M/429)

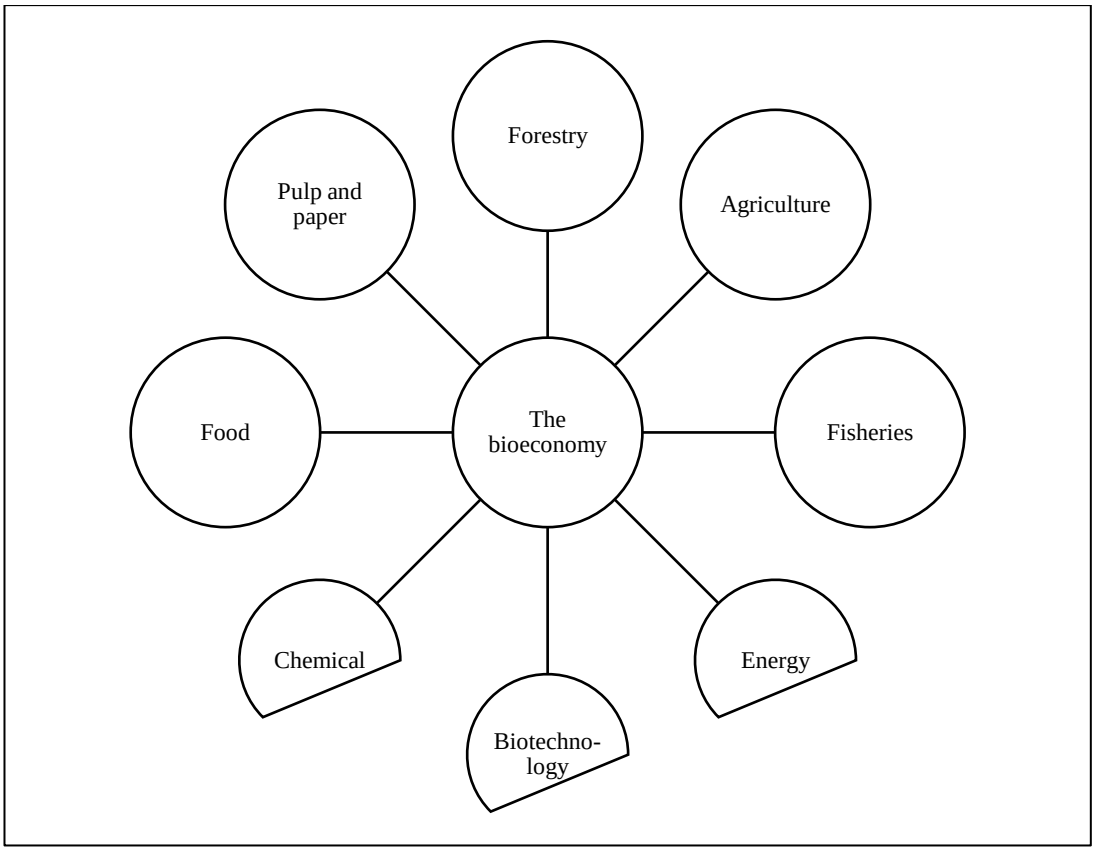

Figure 2.1. The bioeconomy and its sectors. Source: The European Commission (2012).

Other terms that are used often interchangeably include e.g. bio-based economy and knowledge-based bioeconomy. Overall, bioeconomy is often considered as a sector while bio-based economy can be also used when referring to a transformation of the whole economy (Hetemäki, 2014). A term that also often occurs in the discussion on bioeconomy is biotechnology. According to OECD (2014), biotechnology means "*The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services".* In their study, Scarlat et al. (2015) envisage that biotechnology potentially is widely applied in primary production by 2030. It is thus utilized in production of biopharmaceuticals, biochemical, biopolymers, enzymes and biofuels.

Rationale for the increasing use of the term bioeconomy and other similar terms in national policies and strategies is in the growing concern towards environmental threats. The notion of grand challenges has emerged over the last decade (Bugge et al. 2016) to describe these threats that are also often classified under sustainability mega

forces (Pätäri et al. 2016). A common factor for the grand challenges is that they are persistent, very complex and multi-sided and the solutions for them are surrounded with uncertainty, that include e.g. population growth, depletion of many resources and climate change (European Commission 2012). Additionally, because they concern various actors with different interests, they are difficult to manage (Bugge et al. 2016; Coenen et al. 2015). Despite a strong emphasis on the concept of bioeconomy in solving some of these grand challenges, there does not seem to be a strong mutual understanding on what the future bioeconomy ultimately implies (Bugge et al 2016; Meyer 2017).

The concept of green economy also appears often in the bioeconomy policies and literature reviews (see e.g. D'Amato et al 2017). Its meaning is usually considered broader than that of the bioeconomy. In fact, bioeconomy can be thought as a part of green economy, which includes increasing use of biomasses to replace fossil-based materials and other renewable energy forms such as hydro, solar and wind (Hetemäki, 2014). According to OECD document titled "Towards green growth" (2011) sustainable development gives an important context to green growth. In the document, it is mentioned that green growth should be considered a subset of sustainable development rather than a replacement for it.

2.2 Emergence of Bioeconomy strategies

While various national and international strategies demand for a change toward a bioeconomy, a majority of bioeconomy studies have been linked to natural science and engineering perspectives (Kleinschmit et al. 2014) and focused on narrow aspects of a bioeconomy (Bugge et al. 2016). For the various bioeconomy strategies to be successful and gain wider acceptability, it is crucial that decision makers are aware of the stakeholders' possibly conflicting opinions (Pfau et al. 2014).

The European Union has generated its own bioeconomy strategy and a Bioeconomy Action Plan in the early 2010s. Three main areas in the plan include actions in research and development; reinforce policy interaction and actions for the competitiveness of

bioeconomy. Although the goals have respected intentions, there are concern that the Bioeconomy Strategy and the Bioeconomy Action Plan are too optimistic about the possibilities of the bioeconomy. Ollikainen (2014), as one of the major weaknesses in the Bioeconomy Action Plan concern the fact that there is no explicit link to climate policies or that the forest sector is barely mentioned in the EU strategy. Climate policies such as the European Union Emissions Trading Scheme and bioenergy goals have an influence on the use of renewable resources. Therefore, these can change the conditions on how the biomasses are utilized (Ollikainen 2014.)

According to Pfau et al. (2014) despite having good intentions, bioeconomy does not automatically entail generating higher level of sustainability (see also Roos and Stendal 2016). Despite of the regular use of sustainability in literature the term is less frequently defined (Pfau et al. 2014) and the goals for sustainability within bioeconomy are often not clearly presented (Wellisch et al. 2010). As said, the bioeconomy is multi-sectoral covering various industries. Thus, bioeconomy research can be considered a multi-disciplinary field and should be handled in an interdisciplinary way (Pfau et al. 2014). Therefore, it is necessary to recognize and consider insights from different disciplines and stakeholders to succeed in the decided strategies and policies (Pfau et al. 2014). As an example, according to Hagemann et al. (2015) although politics have an important role in fostering sustainable bioeconomy, it is solely not enough if consumers and producers don't accept new policies and their willingness to pay for bio-based products is low.

As an example, taking steps towards the future of bioeconomy will require an increasing use of biomasses, meaning higher exploitation of natural resources from land and sea. This in turn raises questions towards sustainability of a bioeconomy. An important factor that has an influence on this issue are the possible land use changes that aim to gain more land for biomass production. The land area can be changed from forest land to arable land, which potentially releases considerable amounts of CO_2 into the atmosphere. Impacts from the land use changes can be either negative or positive depending on how those are managed (Berndes et al. 2011). In addition, the increased need for forest and agricultural residues for biomaterials could reduce the level of organic matter in soil and decrease soil biodiversity, which in turn has a negative impact on its productivity (Kimetu et al. 2008).

Besides the European Union's bioeconomy strategy, the Organization for Economic Cooperation and Development (OECD) and up to date at least 40 countries have announced their own bioeconomy strategies (Bioökonomierat 2015). OECD's document titled "The Bioeconomy to 2030: Designing a Policy Agenda" (2009) according to Staffas et al. (2013) was partially a reason for the onset for publications concerning the bioeconomy. The document recognize three main elements that an emerging bioeconomy involves: advanced knowledge on biotechnology, efficient use of renewable biomass and integration across sectors (OECD 2009). Countries that Staffas et al (2013) have considered major actors in developing a bioeconomy or that are relatively rich in bio-based resources are USA, Canada, Germany, Finland, Sweden and Australia. According to Kleinschmit et al. (2014), the scope of bioeconomy policies depends on the user, meaning that each of the strategies may cover and different factors of the bioeconomy. The European Union and some of its member states have a focus on the increasing use of renewable biomass as material and substitution of non-renewable materials. OECD and the US on the other hand focus on biotechnology aspect and its role in converting raw material into value added products (Kleinschmit et al. 2014).

According to Meyer (2017), the recent discussion of the bioeconomy strategies has exposed various obstacles and uncertainties, conflicting and contested visions in the bioeconomy. Based on those findings Meyer (2017, p 22-23) identifies five major "stumbling blocks" that threaten the development that the various bioeconomy strategies emphasize for the bioeconomy. Firstly, his study mentions a risk of disappointment. The bioeconomy strategies have far-reaching promises and achieving these could be a difficult task. Secondly, alternative renewable carbon sources exist, which can hinder the development of the bioeconomy. Thirdly, different uses of biomass might create or deepen conflicts. Different uses involving e.g. use of biomass for food, material and energy could give rise to unstable policy support with short sightedness. Fourth, only until new bio-based value chains get broader success will societal conflicts related to the bioeconomy become apparent. As an example, Meyer (2017) points to the biofuel debates in the past, where societal debate and opposition arose after there was a noticeable increase in the production of bioenergy and a corresponding demand for biomass. Fifth stumbling block is about the acceptance of the bioeconomy. According to Meyer (2017), bioeconomy's acceptance could be

compromised, particularly if the bioeconomy policies further ignore the current societal debates on agriculture and food.

2.3 Bioeconomy in Finland

In Finland, the bioeconomy has more than 16 % share of the output in the national economy (Finnish Bioeconomy Strategy 2014), already making it a key activity for the entire economy in Finland. Besides the international bioeconomy strategies, Finland has set its own bioeconomy strategy titled "The Finnish Bioeconomy Strategy" (2014). The Ministry of Employment and the Economy set up a project for the strategy in 2012 and it was published in 2014. Other participants were the Prime Minister's Office, the Ministry of Agriculture and Forestry, the Ministry of the Environment, the Ministry of Education and Culture, the Ministry of Social Affairs and Health, the Ministry of Finance, a technical Research Centre VTT and the innovation fund Sitra. The strategy aims to achieve a low-carbon, resource-efficient society and sustainable economy (Finnish Bioeconomy Strategy 2014).

Besides the ecological aspects the Finnish Bioeconomy Strategy aims to create new economic growth and new jobs, thus it is defined as *"a growth strategy"* (The Finnish Bioeconomy Strategy 2014). This is intended to happen from an increase in the bioeconomy business and in the high value added products and services while protecting the nature's ecosystems. The main idea for the strategy is to create solutions for a competitive and sustainable bioeconomy in Finland and to generate new businesses globally. The strategy sets only a few numeric estimates or goals but it mentions that if actions are made in accordance to the strategy, bioeconomy output will grow from its level of EUR 60 billion in 2011 to EUR 100 billion and create 100 000 new jobs by 2025. The Finnish Bioenonomy Strategy sets four strategic goals that will work as guidelines in implementing the vision and targets of the Bioeconomy Strategy (Figure 2.2). (The Finnish Bioeconomy Strategy 2014. A breakdown of the economic output are presented in table 2.1.

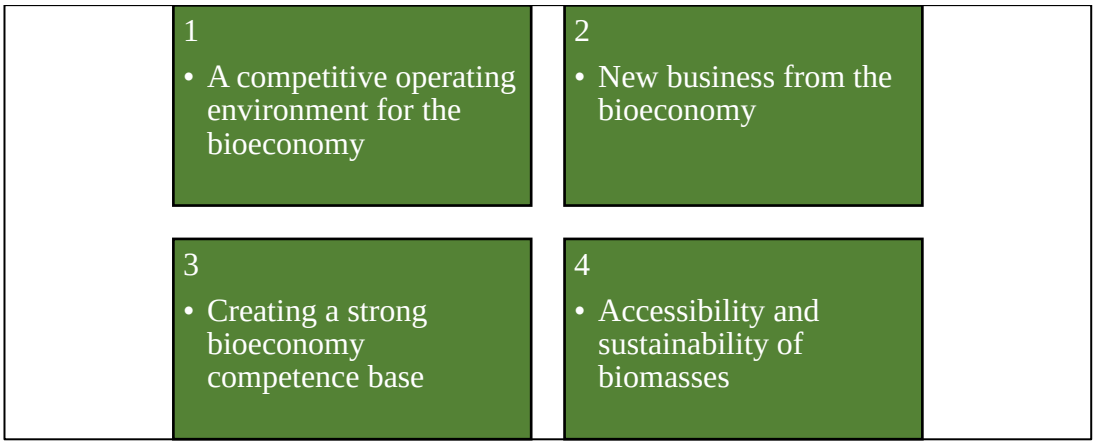

Figure 2.2. The Finnish Bioeconomy Strategy goals. Source: The Finnish Bioeconomy Strategy.

Table 2.1. The bioeconomy output in 2011. Source: The Finnish Bioeconomy Strategy.

	Output million EUR
Food, total	**16093**
Agriculture	4822
Food industry	11271
Bioeconomy products total	**29273**
Forestry	4232
Wood products industry	6870
Pulp and paper industry	13653
Construction	9228
Chemical industry	1644
Pharmaceutical industry	1339
Renewable energy	**4033**
Water treatment and distribution	**610**
Bioeconomy services total	**2993**
Nature tourism	2737
Hunting	85
Fishing	171
Bioeconomy total	**60685**
National economy total	**375777**
Share of bioeconomy	**16,10 %**

The Ministry of Employment and the Economy (2014) has prepared a strategy concerning cleantech sector to support the sustainability visions of bioeconomy policies. The purpose of cleantech sector is to develop and use less environment consuming products, services and technologies (Ministry of Employment and the Economy 2014). It brings solutions to global environment threats such as climate change, resource scarcity and pollutions. In Finland, 59 % of the cleantech companies operate in the field of energy efficiency, which constitutes over a third of the country's turnover in cleantech (Tekes 2013). The cleantech strategy was released in 2014 but put down in late 2015 by Prime Minister's Office as an attempt to create synergies between the bioeconomy and cleantech strategies. However, according to Antikainen et al (2016) the cleantech strategy is partially operating after the new government was chosen in 2015.

Both strategies presume that Finland has excellent preconditions to become the world's pioneer in bioeconomy and cleantech (Antikainen et al 2016). Major advantages for Finland from the cleantech perspective involve features e.g. strong technological expertise and the ability to recognize problems and solutions for them. In terms of bioeconomy, Finland stands out with renewable natural recourses and high industrial expertise (Antikainen et al 2016). Forests belong to the most important recourses of renewable material in Finland. For decades, the country's forest increment has exceeded the harvested amount (Finnish Bioeconomy Strategy 2014). Especially in Finland, forests provide a great share of renewable biomasses. The Finnish Bioeconomy Strategy aims to increase the amount of forest biomasses harvested and used and in the meantime take better care of the climate, forest diversity and recreational purposes of forests (Antikainen et al 2016). With a high emphasis on forests in bioeconomy, it is potential to have an impact on a great number of people in society. According to Metla (2013) a Finnish forest research center, in 2011, there are more than 632 000-forest owners, whose forestland is larger than 2-hectare in Finland.

A research by Kniivilä et al. (2017) studies about the operating environment of bioeconomy in Finland and identifies potential obstacles and bottlenecks that they consider as harmful for its development. Their study lists four forms of obstacles that have a disruptive influence on the development of the bioeconomy. Firstly, the study mentions obstacles concerning people's, companies' and government's attitudes toward new, different products. Secondly, lack of knowledge about the bioeconomy is

considered an obstacle. Thirdly, bioeconomy solutions are considered to be more expensive than traditional solutions and thus economic reasons are one obstacle. Political obstacles are also seen as hindering the development of the bioeconomy as political decision makers may not concretely demonstrate the ambitions about the development of the bioeconomy. (Kniivilä et al. 2017.) Furthermore, growing global concerns towards sustainability issues open new markets for non-fossil-based products (Kniivilä et al. 2017, Korhonen et al. 2015). Besides the policy makers, that create the operational environment for the bioeconomy with e.g. regulations, Kniivilä et al. (2017) add that other main stakeholders within the bioeconomy are production companies, material suppliers and consumers who set the demand for the products and services.

2.4 Forest sector in the bioeconomy

In EU, forest sector accounts for roughly 31 % of the bioeconomy's turnover and 22% of the employment (Hetemäki 2014). Forests cover approximately 42 % of the European Union's area (Scarlat et al. 2015) and they are a significant producer of whole world's renewable biomass. Forestry's special advantage compared to other biomass resources is its large production potential, which does not threaten food security (Ollikainen 2014, Roos and Stendal 2016). According to Panwar et al. (2016), wood is globally the most abundant source of non-food biomass with 44% share of the earth's biomass. A major part of utilized wood comes from forests and smaller parts of wood comes from short rotation coppice and landscape residues (Hagemann et al. 2015).

Hetemäki & Hurmekoski (2014) describe that the forest sector is in a process called *"creative destruction"*, a notion generated by Schumpeter (1942) who describes it as a process where an industry continuously develops the economic structure from within and continuously creating destroying and replacing the old one with a new one. In the case of forest sector, demand of a number of incumbent products and businesses are strongly declining, and meanwhile new products and businesses are emerging

(Hetemäki & Hurmekoski 2016). The Figure 2.3 shows the general structure of forest products innovations today. On the base level are the product or innovation groups with a low value-added and on the top are the innovations with high a value-added.

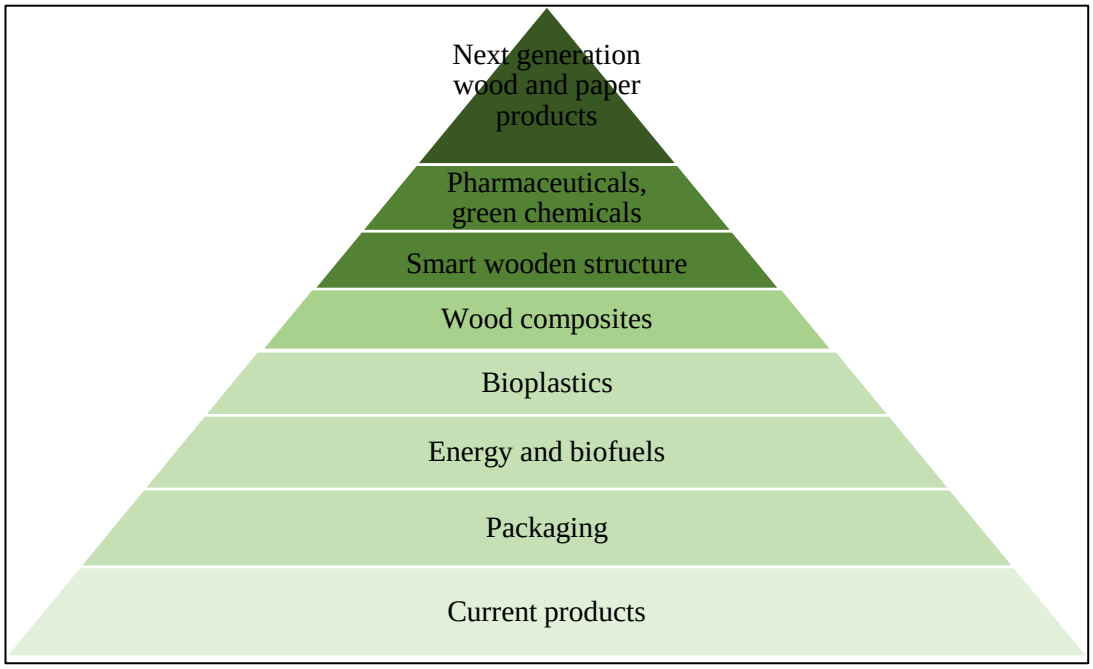

Figure 2.3. Forest product innovations. (Modified from: Metsäteollisuus 2009)

The ultimate contribution of forests to the bioeconomy depends on the production capacity of forest raw materials that can compete with or substitute non-renewable materials. Because forest industry companies are suppliers of bio-based materials, they are naturally in a position to capitalize on upcoming market trends regarding bioeconomy (Hansen 2016). However, companies within forest industry must be prepared to establish successful strategies to meet with the needs in bioeconomy, especially when biorefinery development is targeted (Chambost et al. 2009). The forest products market has gone through a major change in 21th century (Hetemäki 2014). During that period, the European Union's and North America's share of the global forest products production has decreased, following the decrease in their absolute levels of production and also decreasing consumption of for example publishing papers (Hetemäki 2014). In the meantime, many countries in the emerging economies (e.g. China, Brazil, Indonesia and Russia) are increasing their share of production (Hetemäki 2014).

All in all, the development of bioeconomy presents opportunity for companies in forest sector to diversify their product offerings, which in turn decreases the dependence to stagnant markets with mature products (Hansen 2016). Figure 2.3 also illustrates the development needs of forest products innovations when moving up the value pyramid. The traditional sectors such as sawn wood, pulp and paper and energy will remain their core role in forest-based bioeconomy still for some time (Panwar et al. 2016). Future applications for wood involve more value added products e.g. new industrial building systems such as cross-laminated timber in tall buildings and glulam in large halls and warehouses, second generation biofuels and more advanced chemicals, wood plastic composites and nanocellulose (Panwar et al. 2016). What is common for products on each level of the pyramid is their environmental dimension compared to products that use other materials, especially non-renewable ones (Hansen 2016).

While forest sector is competing in mature markets, bioeconomy is an opportunity for numerous forms of innovations (Hansen 2016). Literature suggests that the sector is known for its strategic focus on process innovation, high-volume production and low costs (Pätäri et al. 2011, Toppinen et al. 2013) rather than creating new products and business systems (Hansen 2016). One reason for this lack of innovation is the sector's maturity and positioning on the innovation cycle (Hansen 2016). Compared to other sectors, forest sector is considered to be slow in adopting innovations and improvements, which are also typically process-oriented and incremental (Panwar et al. 2016). According to Wagner et al. (2005) wood products industry typically involves high capital intensity for investments in new technologies. This is a requirement that large companies have a better ability to accomplish. On the other hand, large companies may suffer from different issues that decreases their innovativeness (Wagner et al. 2005). Ollikainen (2014) also stresses that forest industry needs to create high value-added products to replace the decreasing demand for paper. Additionally, to create new markets for bio-based products the industry needs to be able to compete with fossil based products in terms of cost effectiveness and technical performance (Scarlat et al. 2015) but also in terms of improving e.g. customer, service and sustainability orientation (Toppinen et al. 2013).

2.5 Fiber-based packaging

Today, packaging is an important part of companies' operations. It has a large impact on society and in the lifestyles of many consumers. Packaging is behind the performance and functionality of production, logistics and marketing systems (Olsmats & Kaivo-oja 2014). Packaging industry exploits several different materials from which packaging paper and paperboard are the most used materials worldwide with a global market share of 35% with the second most important material in packaging being plastics (Hetemäki 2014). Other packaging materials include metal, glass and wood. With a combined share of more than 70% of the total materials used in packaging, packaging paper, paperboard, and plastics dominate the markets. Thus, the competition between these two materials is an important factor in determining on how the paperboard sector will develop in the future (Hetemäki et al. 2013).

The development of information technology and digital media have set the consumption and price trends for graphics paper products into decline. Whereas these trends are not expected to have such effect on paperboard consumption. In fact, trends like Internet trade partly increases the need for packaging and packaging materials (Hansen et al. 2013). The growth in consumption of packaging paper and paperboard has been relatively stable during the last two decades with an annual growth rate of 3,3% (Hetemäki 2014). The global production of paperboard correlates highly with the consumption of containerboard that is used for bulk packaging of industrial commodities (Hetemäki 2014). According to the World Packaging Organization, main growth opportunities for packaging exists in such areas as fresh food and ready-to-eat meals especially in developing countries (WTO 2008). According to Olsmats & Kaivo-oja (2014), the main end use sectors for packaging products are food and beverage sectors, which together account for around 50-60% of the total markets. On the second place is the health care and cosmetics.

Currently the largest producer and consumer countries of paperboard are the United States, China and Japan (Hetemäki et al. 2013). A strong structural change is affecting the consumption and production of paperboard markets. The change is due to a remarkable growth in production and consumption in Asian markets, mostly resulting from the fast economic development in China. This has led to a situation where a great

amount of production of consumer and industrial goods has increasingly been shifted from developed countries to emerging economies, like China's. Following this trend, packaging industry has also migrated to areas where the packaging of the goods happen, increasing their production capabilities. Western Europe and North America are two areas where the consumption per capita has decreased the most in 2000s. Nevertheless, they have been able to compensate the sluggish national demand with increasing exports. According to Hetemäki et al. (2013), they will continue to be important exporters of paperboard in the future. Regions such as Africa, Latin America and Eastern Europe are dependent on imports and it is likely, that the growth will continue. Asia is also importing more than exporting and in addition investing in new capacity to react to growing demand for paperboard (Hetemäki et al. 2013). The ongoing development where the low-cost, emerging economies have increased their production of paperboard and is effecting the global price for paperboard. During the last decade the price trend has evidently been decreasing, which is a challenge particularly for the Western European and North American producers (Hetemäki et al. 2013). To become more competitive, Olsmats & Kaivo-oja (2014) suggest, that packaging producers need to start providing customers with lean solutions, more services and higher value.

The global economy is a central driver for the growth of the market. In addition, several other factors have a direct influence on the demand for packaging materials not to mention the indirect influences. A study of Olsmats & Kaivo-oja (2014) recognizes major drivers and trends influencing the demand for packaging (Table 2.2).

Table 2.2. Key megatrends and challenges influencing the packaging sector. Source: Olsmats & Kaivo-oja (2014).

Clustered Megatrend/Challenge	Opportunities	Threats
"More from less"	Product protection Packaging to reduce (food) waste (e.g. fully emptiable, multi-packs, re-closable, smaller size etc.) More people—higher food demand Lean packaging Support sustainability at a higher level (product, business, value chain etc.) Proactively shape and define sustainability and sustainable packaging	Deepening poverty due to over-exploitation of natural resources Increasing material prices Increasing energy prices Scarcity of water, energy etc. Competition for raw material to other products (including bio-energy) Competition for forest land use to agriculture, housing, infrastructure etc.
"A personal touch"	Packaging—a materialized service Added value by packaging Sustainable packaging/packaging to support sustainability Bridge gap between end-user and material New business models	Consumption of services instead of goods
"On the move"	Packaging logistics efficiency Packaging barriers—shelf life Lifestyle enabler Integrated waste management solutions Urbanization can pave the way for more efficient production and distribution	Recycling and waste management availability, convenience and capacity
"Divergent demographics"	Universal packaging design Growing middle class Growing prosperity Healthy food Functional food	
"iWorld"	Smart packaging Logistics efficiency New business models and products Tagging Free content—product samples Packaging as a link to the digital world	Physical products replaced by virtual products IPR of packaging and product designs

The future of the market of paperboard is increasingly dependable on China's economy. This issue creates uncertainty and makes future's development projections more difficult. Another future uncertainty concerns the development of possible new packaging materials and new packaging innovations according to changing customer behavior. These developments and innovations may include e.g. nanotechnology, intelligent packaging and high barrier materials (WPO 2008). In addition, growing environmental concerns towards the sustainability will most likely be an important factor in packaging sector.

Rokka & Uusitalo (2008) studied the consumers' choices regarding the packaging materials. Their findings underline the increasing importance of ethical and environmental dimensions in product choices. As a more specific result, they found out that the largest segment of consumers favored packaging with environmental labels as the most important criterion in their choice (Rokka & Uusitalo 2008). Another study by Löfgren & Witell (2005) concludes that the recyclability is an important factor in consumers' choice making as it is an important tool in preventing waste, saving resources and in protecting products. In addition, their study points out the increasing role for packaging as a tool and a marketing device. With the major growth potential, that paperboard as a packaging material has, the competition with plastic as a packaging material is a challenge. Especially rigid plastics have been and according to WPO (2008) will continue to be the fastest growing material in packaging industry.

3 Theoretical framework

3.1 The future development pathways of fiber-based packaging sector

In this study, the concept of acceptance is applied to understand in which condition different stakeholders in Finnish packaging sector perceive the role of fiber-based packaging business sustainable and successful in the bioeconomy transition.

The theory of acceptance can be helpful in studying the success of diffusion of new technologies or understanding the role of nature conservation (Schenk et al. 2007). The concept of acceptability does not have any one definition, but Nielsen (1993, p. 24) describes acceptance as being a question of whether the system satisfies all the needs and requirements that users and other stakeholders have. Schenk et al. (2007) compare diverse studies that use acceptance theory and as a conclusion, they found out that the mechanisms of acceptance are usually very similar and do not depend on the object of acceptance. Overall, it is a widely used concept in research and in everyday contexts (Schenk et al. 2007).

The acceptability hierarchy framework by Mikkilä (2003) can be used to assess corporate social performance. The framework is large; it is composed of multiple levels and involves multiple stakeholders. Thus, the area of the model widely covers various aspects of what is studied in this research and hence serve the study well. The framework is however modified for the specific purposes of the study. This is done by combining Mikkilä's (2003) framework of acceptance (Figure 3.1) and the potential future pathways using Priefer et al (2017) framework as a guidance.

The Figure 3.1 outlines the key themes relevant for this study at each level of acceptance hierarchy in the context of the development of the bioeconomy in packaging sector.

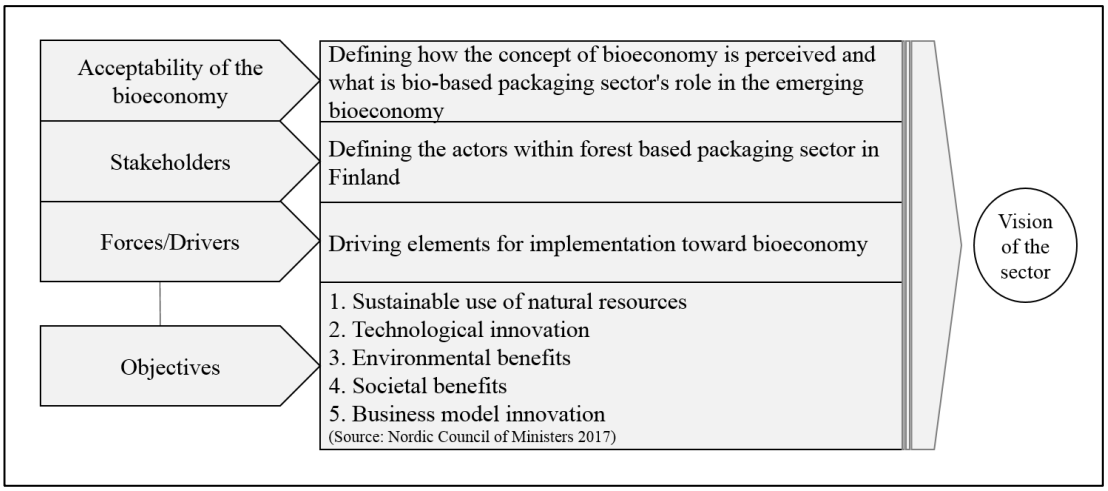

Figure 3.1. Theoretical framework of the study based on Mikkilä (2003), Priefer et al. 2017, Nordic Council of Ministers 2017.

Firstly, the aim is to outline, how the concept of the bioeconomy is understood and what are the stakeholders' views about the role of the fiber-based packaging sector within the emerging bioeconomy.

Secondly, of the key stakeholders are identified and actors of fiber-based packaging sector in Finland, and their role in the emerging bioeconomy is assessed. To ensure a holistic view on the development of the bioeconomy it is important to include all the stakeholder groups in the model, although in this study, industrial views are emphasized.

Thirdly, the study aims to evaluate which pathway the development of the bio-based packaging is likely to follow using Priefer et al. (2017) categorization of the core elements as key drivers of the bioeconomy (Table 3.1). The original framework with ten elements was modified so that five of them were chosen to be used in the questionnaire. The decisions were made due to overlapping of the elements and because the chosen elements were seen to serve this study the most. In the interview analysis, the results were divided so that four of the elements were focused on. The elements that were used in analysis involve understanding of sustainability, resource utilization, consumer behavior and innovation.

Table 3.1. Implementation pathways for the bioeconomy (Modified from Priefer et al. 2017)

Implementation Pathways		
Elements	**Technology-Based Approach**	**Socio-ecological Approach**
Understanding of sustainability	Sustainability as an implicit result of the bioeconomy	Bioeconomy will contribute to sustainability if certain preconditions are met
Resource utilization	Increased resource efficiency due to new conversion technologies (lower raw material input per unit of product)	Reduction of resource demand by implementation of a circular economy
Consumer behavior	Technology will bridge resource gaps, persistence of today's consumption patterns	Sufficiency approaches and sustainable consumption
Innovation	Technology leadership, intellectual property (e.g. patents) and multinational companies	Promoting social innovations, use of the local experience of different stakeholders and tacit knowledge of farmers

The technology-oriented pathway believes in technological development and increased efficiency in biomass usage. This pathway, considers sustainability as an implicit result of the bioeconomy and that the increased use of biomasses will in the long run solve the problem of resource scarcity. (Priefer et al. 2017.)

In the alternative socio-ecological pathway, the focus is on site-specific, regional solutions that are based on flexible networks and additionally, on the reduction of resource demand by implementing circularity. In the socio-ecological approach, bioeconomy will contribute to sustainability only if certain conditions are met (Priefer et al. 2017). In addition to sustainability, the resource utilization, consumer behavior and innovation are identified as key drivers of the development.

The importance of innovations becomes eminent from e.g. Van Lancker et al. (2016), postulating that radical and disruptive innovations will be needed to transform the current fossil-based economy to the sustainable bioeconomy. In addition, they point out the necessity of cooperation between different value chains and sectors within bioeconomy (Van Lancker et al. 2016). Boons et al (2013) recognize an increasing interest toward sustainable innovation and economic performance during the last five years. Schaltegger et al (2016) claim that a major source behind sustainability concerns

such as environmental and social problems are the business activities on the globe. Therefore, companies' role is significant in transforming markets and society towards greater sustainability (Geels & Schot 2007).

Along with the objectives related to human rights, good quality of life and equality, the model by Mikkilä (2003) outlines profitability, economic growth, economic, ecological and social sustainability as key objectives. This study aims to critically evaluate how different stakeholders along the fiber-based packaging value chain view these objectives together with five-stage criterion set by the Nordic Council of Ministers (Nordic Council of Ministers 2017) (Figure 3.1). Criterion developed by the council presents five point which measure sustainability and innovativeness of bioeconomy activities. An overall target of their framework is to be able to push for clear and consistent targets and indicators to manage the economy transition towards greener economy (Nordic Council of Ministers 2017).

4 Methods

4.1 Data collection and analysis

This study uses interview-based primary data, which means that the researcher collects the data himself. This way of approaching enables the researcher to get a more comprehensive understanding about subjects' opinions and therefore supports in creating an understanding about the key issues and topics from the whole sector's perspective.

The questionnaire that was used in this study involves twelve questions from which one is divided into five sub questions assessing each of the elements that were chosen from the implementation pathways framework by Priefer et al. (2017).

The questionnaire constitutes of three parts. First part with two questions focus on studying the subject's own background and additionally his or hers company's role in the fiber-based packaging sector. These questions give the interviewer an idea about the interviewee's expertise and knowledge, which the interviewer can use to steer the discussion as wanted.

After that, the next part with four questions ask the interviewee about their views and opinions about the concept of bioeconomy. These questions provide data that enables an analysis about the understanding and perceptions about the concept in the fiber-based packaging sector. Additionally, these questions are closely similar to part of the questions by Hodge (2016) enabling comparison between the results. As the questions regarding the bioeconomy are broad, they may require plenty of time depending on the interviewees.

The last part includes six question from which one assesses five elements in the implementation pathways framework by Priefer et al. (2017). It focuses on studying the influences that the bioeconomy has on the fiber-based packaging sector. Although the framework is assessed in its own segment, also discussion about other parts of the questionnaire, mainly the third part, is used in analysis about the possible future

pathways. This is possible mostly because the questions are future oriented. Here, to ensure suitable analysis and comparable answers, the interviewees are asked to describe the sector's future toward year 2030.

4.2 Methods

A semi-structured qualitative interview was selected as a method of collecting data in this study. A qualitative interview aims to understand a subject's view of the world prior to scientific explanations (Kvale & Brinkmann, 2009, p 1). A semi-structured interview with open-ended questions enables an interactional dialogue between the participants, where the interviewer has a list of questions or topics that are meant to be covered in the interview. However, there is certain flexibility and the interviewer may decide to ask additional questions on the spot, if it is seen necessary (Hammersley, 2013). Open-ended interview questions are identical for every interviewee, but because they are open-ended, they enable the subject to fully express their opinions.

The subjects for the interviews were selected using a method called purposive sampling. It is a method, where the interviewees are chosen according to a set of criteria, made prior to the study. According to Patton (1990), the benefit in purposely selecting the interviewees, is in achieving information-rich candidates, which enables high learning potential about the important issues.

4.3 Data analysis

A qualitative research approach enables a flexible interaction and a possibility for the interviewer to engage with research participants. It is often fieldwork, where the interviewer or the researcher observes and records the interaction with the participants. A qualitative research enables a recording of peoples' feelings, perceptions, and

experiences for the researcher to interpret. (Simion, 2016). According to Alasuutari (1994, p. 31-48) a qualitative analysis constitutes of two phases. Firstly, it reduces the amount of raw data to include only data that is essential for the study. Within this phase, it is possible to reduce observations further by joining together observations with similar features. Secondly, the results are interpreted and the findings are studied.

In research, validity measures the accuracy and truthfulness of scientific findings (LeCompte & Goetz, 1982). According to Brink (1993), different types of validity exist and different terms are used for them. However, two major forms of validity can be identified: internal and external validity. Internal validity is concerned about which research findings reflect or represent the reality, and in this study it was ensured for example by choosing interviewees with high-level of expertise in the subject matter. External validity on the other hand measures the degree of how applicable the representations or reflections are across groups (Brink 1993), and when using a case of fiber-based packaging in Finland the man aim is not on generalizability over other contexts.

According to LeCompte & Goetz (1982), reliability of a research can also be examined from internal and external perspectives. Internal reliability addresses to how other researchers, with a set of previously build concepts, are able to match with the data collected by the original researcher. External reliability observes if a researcher can build the same constructs or find the same phenomena in same or similar situation. Reliability about the results in this study was ensured by including authentic. The amount of quotes of different stakeholder groups was aimed to be approximately relative to the number of interviewees within each stakeholder group. It ensures that all of the groups are considered in the results and does not distort the results to overweight one of the groups.

In this study, the chosen organizations were selected to comprehensively present different parts of the Finnish bio-based packaging sector. Although a comprehensive outlook was partly the aim of the study, the focus was following the research plan. The interviewees can be categorized to represent following stakeholder groups: industry, NGO, government and research. Table 4.1 presents distribution of the interviewees across different stakeholder groups.

Table 4.1. Interview categories

Category	**Number of interviewees**
Industry representative	9
Government representative	1
Research representative	2
NGO representative	2

The subjects within an organization were selected based on their job description and position in the organization. To enable a comprehensive understanding of the sector, different backgrounds were considered in the selecting process; however, different managers were favored to ensure the subject's knowledge about the related topics.

In this study, transcription was mostly done by Tutkimustyö Oy and in a couple of cases by the author of this study. The transcriptions were later uploaded to ATLAS.ti software that was used as the main tool in analysis. From the transcriptions', direct discussions answering the questions in the questionnaire was firstly identified and coded. After this, repetitive topics and topics with indirect relation to questionnaire were identified and coded. Lastly, points in some topics were coded to enable creating lists or tables for the results. In addition, some of the discussions was cross-coded to also enable analysis about the implementation pathways framework (Priefer et al. 2017) was coded.

4.4 Interviews

Fourteen interviews were held over a period between 17 April 2017 and 22 May 2017. The interviews lasted from 40 minutes to 90 minutes with an average duration of approximately 60 minutes. Four of the interviews were done by phone or by using a video conference call software such as Skype. Ten interviews were face-to-face

meetings usually in locations chosen by the subjects, e.g. their offices etc. Interviews were recorded and transcribed to ensure data storage and to help in analysis.

In case of a face-to-face interview, the questionnaire was printed so that both the interviewee and interviewer had a possibility to read each question. Additionally, the table based on Priefer et al. (2017) was printed and used in the interviews. In case of conference call interviews, the questionnaire was sent to the interviewee by email and in the beginning of an interview the interviewer made sure that the questionnaire file was opened.

5 Results

5.1 Structure of the results

The results are presented so that firstly, the chapter 5.2 discusses about interviewees perceptions about the future aspects in the bioeconomy. The later chapters focus on different elements that are derived from the implementation pathways model for the bioeconomy. The use of this framework enables an assessment about possible future pathways for the emerging bioeconomy in the Finnish fiber-based packaging sector as it provides a tool that can be used to systematically outline the experts' opinions of crucial elements and their interdependencies for the development of the bioeconomy.

5.2 Current understanding of the concept of bioeconomy

On a general level, the whole stakeholder group shared a rather mutual understanding about the theoretical description of the concept and it was generally described as "*the economy of future"* (Research representative) and *"an economy based on renewable resources"* (Industry representative). One industry representative whose citation sums up well the overall opinion about the concept described it as follows:

> *"I think that the bioeconomy is a sustainable form of economy that uses natural resources sustainably, creates wellbeing, jobs and tax revenue and keeps this society going."- Industry representative.*

A government representative shared the same view while adding that besides the material dimension, the concept of bioeconomy additionally involves ecosystem services. Therefore, according to the interviewee, "bio resources" would describe the concept more holistically than a term "biomasses", additionally involving natural processes and immaterial values. However, the government representative also highlighted the concept's economic dimension by stating the following: *"the*

bioeconomy is however, a term about economic growth" (Government representative). All stakeholders generally understood and accepted that economic values have a key role in the bioeconomy.

Several interviewees saw the bioeconomy to be something else than manufacturing of only traditional bio-based products. Instead, it was considered to have an emphasis on innovations and on more developed products than *"the traditional two by four"* (Industry representative), as described by one interviewee. The level of which products may be considered as bioeconomy differed among the interviewees. For some, all efficiently managed production that uses bio-based materials was considered as being part of the bioeconomy. For some, the bioeconomy presents itself mainly as new products that are able to replace products that were formerly made out of non-renewable materials as described in this quotation:

> *"When the forest industry can, with their own expertise and production replace a resource that was formerly made of non-renewable material that can be called bioeconomy" – Industry representative.*

An alternative view was that for a company to develop into a bioeconomy company it takes time to generate the expertise and buildup useful, profitable bioeconomy concept. Thus, it links to the idea of being able to use more fiber in production by using material more efficiently. This opinion was described as follows:

> *"I think that you cannot just like that born to be a bioeconomy company, but you need to build the solutions and ways of operating and develop kinds of reasonable bioeconomy concepts [efficient and sustainable]"- Industry representative.*

Despite the closely uniform understanding on theoretical level, there were still several uncertainties and conflictive understandings about practical scope of the subject. One point of contradiction that came up in the interviews has to do with the bioeconomy's ability in actually being able to create something concrete for the fiber-based packaging sector. Here, the opinions differed broadly, with one extreme claiming that the concept itself has nothing to offer for the industry by stating the following:

> *"[The bioeconomy is] a Trojan horse concept. It is a new term that is used to dress old things to drive [actors'] own political agendas" – Industry representative.*

However, the same industry representative also said that the bioeconomy is essentially *"An economy that uses renewable biomaterials"* sharing closely the same theoretical understanding with rest of interviewees. Another industry representative expressed his view that many Finnish companies within the fiber-based packaging sector already operate within preconditions of the bioeconomy. Thus, the concept and its development are extremely important for the whole forest sector and for the fiber-based packaging sector in Finland. However, the same interviewee saw nothing new in the concept and stated as follows:

> *"I think that there is nothing new or miraculous in it [in the bioeconomy], maybe it has not been used in marketing before or differentiated [as a sector] […]" – Industry representative.*

The previous citation refers that especially this industrial interviewee sees the bioeconomy narrowly from a marketing perspective. Another industry representative's comments were in line with this view:

> *"[…] [the bioeconomy] it is nothing new in the Finnish forest industry, it is clearly a fashionable term like "cleantech" is today but if we take a look at it, for example from pulp mill's byproducts one has already manufactured turpentine and pine oil and other things and sold those before." – Industry representative.*

As the previous example suggest, several industry representatives perceived the bioeconomy concept to represent a marketing term. The concept was additionally described as *"re-branding for sure"* and *"Quite often I think that it is a marketing term. And branding".* One of the industry representatives described the increasing use of the concept by claiming the following: *"the bioeconomy is a model that aims to broaden forest industry's scope"*, also stating that the concept is mostly a new marketing term for old products. Although it was considered to be used in re-branding/marketing the sector, many of the industry representatives claimed that with their customers they do not use the word "the bioeconomy" directly but different

concepts, which they classify as belonging under the bioeconomy concept. Examples of these features that the bioeconomy is considered to involve according to the interviewees are presented in table 5.1.

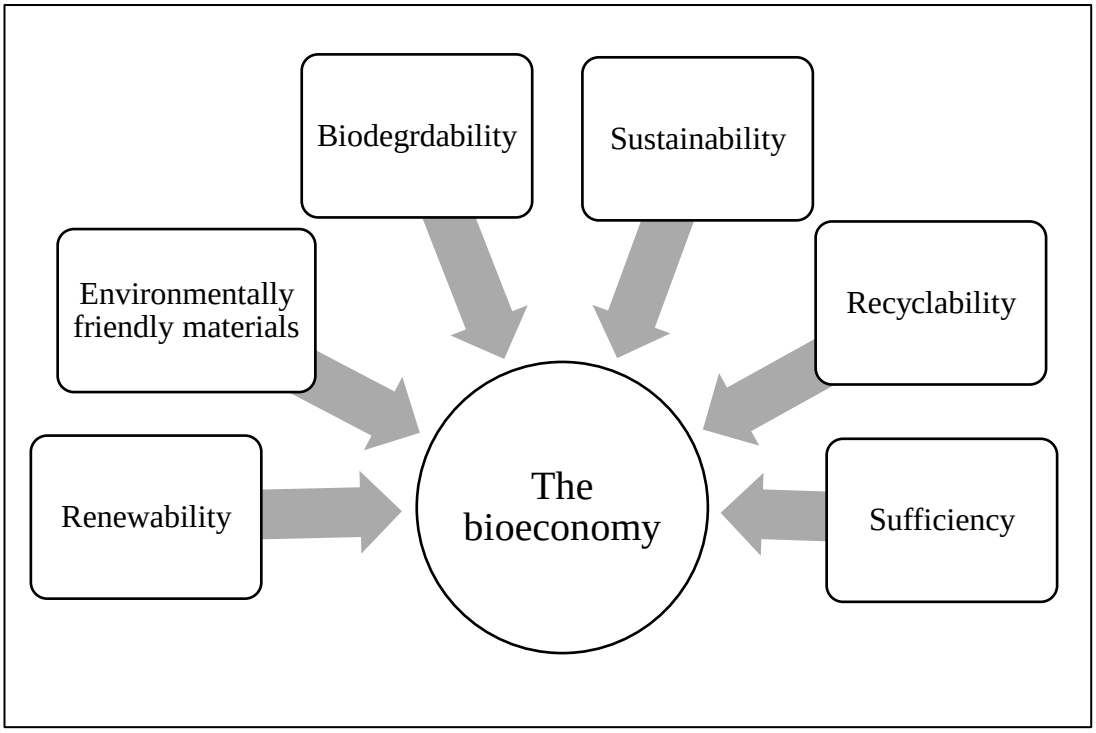

Figure 5.1. Alternative ecological features of the bioeconomy according to the interviews.

Although no industrial informant admitted that their company uses the concept of bioeconomy in their operations, the industry representatives expressed different opinions where some saw great benefits with the term as was expressed here:

> *" I see many opportunities. I mean this is a great… [Opportunity]" – Industry representative.*

Here, the same interviewee additionally expressed that the openness of the concept is a positive thing and that it is a multidisciplinary concept that unites different sectors and creates synergies by stating the following:

> *"And then one has found all kinds of medical properties or healing properties [from traditional forest industries]" – Industry representative.*

A general view among the industry representatives was that because they see forest and fiber-based packaging industries to be quite in the core of the bioeconomy, its rise or as some rather expressed it, the rise of appreciation towards ecological values would directly help them in their businesses as well. Those industry representatives who thought that there is no benefit in using the word "the bioeconomy" however, agreed that the companies who are able to use sustainability related arguments in their operations would be the winners in the long run. Here, the interviewees generally considered that companies with sustainability arguments would get the highest acceptance among the markets were they operate. Thus, the industrial operations and investments will steer toward greater sustainability. Thus, the skepticism expressed by some of the industry representatives is linked to the use of the term itself, rather than the potential ecological and economic factors that the bioeconomy, according to the interviewees and a body of background literature, contains.

Interviewees from other stakeholder groups saw the bioeconomy concept as a "positive discourse" and generally had mutual understandings about the bioeconomy as a concept that concerns various sectors. The government representative saw the concept as opening the frame of reference, which means that it has steered more emphasis to develop new value chains and better exploitation of byproducts. For politicians, bioeconomy discourse has additionally linked the climate change issue more closely with bio-based businesses. A research representative saw the concept as a way of thinking, where almost anything can be made out of forests and biomaterials. Additionally, one interviewee described the bioeconomy to be:

> *"[…] an important source of regeneration, maybe some kind of an inspiration source, or a sort of catalyst" – Research representative.*

Similarly, an NGO representative saw the bioeconomy to be a *"mutual ambition"*, where industries and government increase their investments and contribution to develop the sector.

Furthermore, the research representative saw that currently in Finland, the bioeconomy faces a problem called "silo effect" where information does not get transmitted between the silos, in other words, from stakeholder-to-stakeholder or from sector to sector. He expressed following aspect about the issue:

"[…] between interfaces there are big innovation opportunities. In the bioeconomy there are more opportunities if we, somehow, could avoid this silo effect" – Research representative.

In addition to industry representatives' opinions, interviewees from other stakeholder groups also perceived that in the future, a company that is able to take an advantage of sustainability factors in its operations will be successful as demand was overall considered to shift more toward sustainable products and services. However, as a discourse the conceptual understandings were found to differ as is presented in figure 5.2. In the figure, size of the circle demonstrates the order of how strongly and how often each of the tree opinions were expressed, biggest being the most dominant. Mostly the differences occurred between industry stakeholders and the rest, and within the industry representative group. The industry stakeholders generally were more skeptic about the use of the concept and had overall mixed feelings about its significance. One reason behind the skepticism may be in the complexity and unclearness of the concept as mentioned by an industry representative:

"Yes, of course, it is a positive word but the contents are in my opinion, a little unclear" – Industry representative.

Because of this, there seems to be a threat that the concept of bioeconomy and other environmentally related terms and concepts are consciously or unconsciously mixed and become watered-down ideas when used with wrong intentions. An industry representor explained this concern as follows:

"There is a threat that when you have kind of instances that maybe drive their own intentions, use the [sustainability related] terms, either knowingly or un-knowingly in a wrong way to create wrong assumptions" – Industry representative.

According to the industry representative, this has already occurred. Thus, it can be argued that negative side effects of the bioeconomy exist and that those already have appeared. Their further appearance could potentially hinder the development of the bioeconomy in the future.

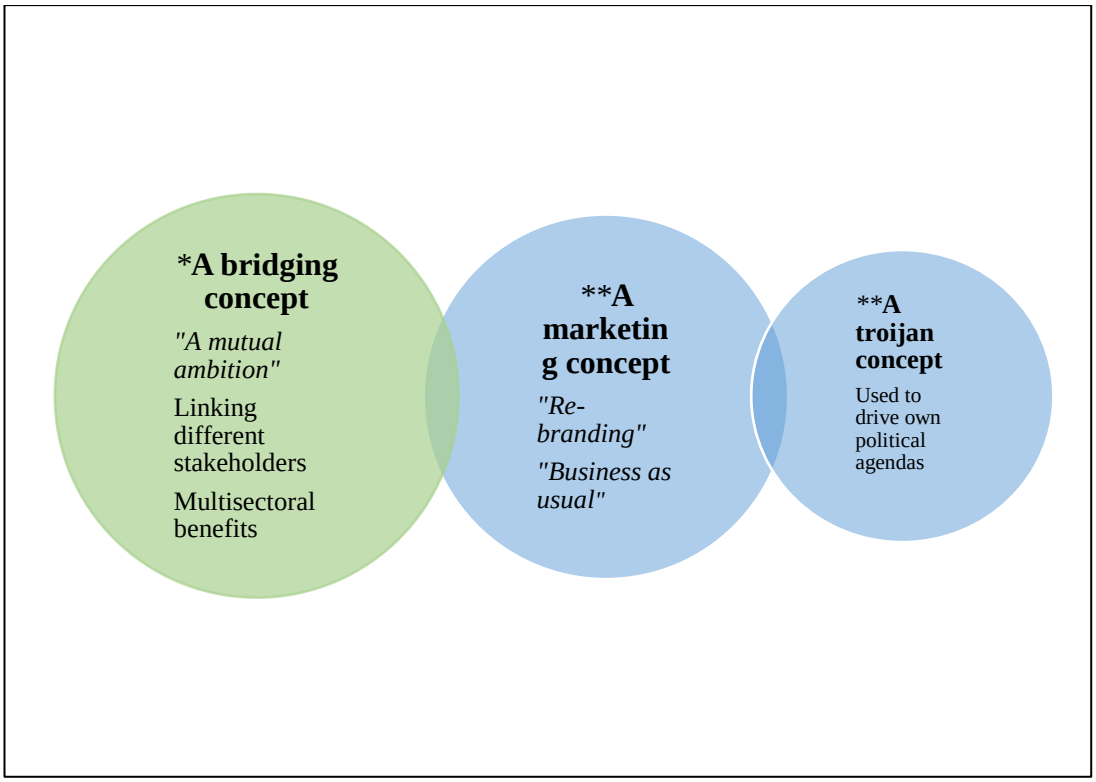

Figure 5.2. Mixed opinions about the notion of bioeconomy . *(* research, NGO and governmental representatives; ** industry representatives).*

Regarding the issue of which of the stakeholder groups are most crucial for the future evolution of the bioeconomy, the results of this study highlight the importance of incorporating the views of all of the different stakeholders along the value chain. However, the emphasis of the role of different stakeholders in bioeconomy's development differed greatly across the interviewees, and brand owners' and different political actors' roles were found to be highlighted the most often. Many industry representatives claimed that already with today's technology it is possible to make more products from fiber-based materials than what is released on the markets mostly due to higher prices. Thus, the interviewees possibly consider that the most probable way of introducing new fiber-based products to the markets is either by political decision that some way influences the markets so that fiber-based products become a competitive option. The other channel to introduce new fiber-based production to the markets is brand owners, who make the final decision of which products they sell.

The strong emphasis of brand owners in the development of the bioeconomy by several industry interviewees, as well as research and NGO representative derive from two alternative future aspects. Firstly, it was acknowledged that the bioeconomy's actual

development would need sufficient recourses and persistent contribution that only major, globally known companies have. Here, retailers and brand owners roles' were highlighted as they are seen to really push the sustainability related innovations forward. An industry representative gave a following example on how they offer their new products or ideas to their customers:

> *"When we develop new products, new ideas, we of course have to toss the ball back and forth with brand owners to get them interested, so that they will tell their suppliers that they want these things […] in a way you have to market far enough [to reach all the main stakeholders] to get things going." – An industry representative.*

Secondly, brand owners were seen as the most likely stakeholder group to have an influence on nudging the consumer behavior towards sustainability, which is considered important in putting the transition toward the bioeconomy ongoing. An industry representative commented this as follows:

> *"[…] the guidance comes pretty much from brand owners who have the idea about what we want to start selling" – Industry representative.*

A rather commonly shared opinion was that although the interaction between brand owners and packaging manufacturers may be effective, the brand owners often set the ultimate requirements as claimed by a research representative as follows:

> *"The one who has the main responsibility in the consumer behavior is actually the one who creates the brand and the product image […]" – Research representative.*

Political decisions were additionally found to be important in guiding the bioeconomy development. Some interviewees saw it even as the most effective way of influencing, as is shown here:

> *"[…] as I said, politics, decision makers have a huge role here." – Industry representative.*

The ways of how to politically influence the bioeconomy were not often discussed directly but as something that was mentioned considered weakening or restricting the use of some competing, non-renewable materials such as plastics and therefore

enabling the increased use of fiber-based materials. However, concerns were raised about politicians' capabilities in considering packaging sector's influence to sustainability through a products whole life cycle as was mentioned by an industry representative as follows:

> *"I can say that in politics, EU, Brussels, they do not necessarily see the bioeconomy as a holistic cycle [and considered the whole life cycle of a product]. They might have a weight in recyclability, toxicity and not in the sustainable use of materials." – Industry representative.*

In addition to the weight of brand owners and governments, the representative from research community claimed that different NGOs are increasingly affecting the bioeconomy development. An industry representative's words supported this by expressing that in their company, communication between NGOs about sustainability issues, mostly about sustainable forest management, happen frequently.

5.3 Understanding sustainability as a core element

Sustainability as a core element of the developing bioeconomy seems self-evident, since something regarding ecological factors or sustainable growth came spontaneously up in every interview. Thus, sustainability appears to have a strong influence in the overall understanding of the whole concept, and potentially it continues to have a strong role behind the emerging bioeconomy towards the future. Overall, the interviewees' perceptions were rather uniform about the understanding of sustainability element.

The interviewees unanimously, regardless of the stakeholder group they represented claimed that "to be truly sustainable, the bioeconomy needs to be properly executed". Generally, the interviewees perceived sustainability issue to be broad and complex, where nothing is black and white, which emphasizes the socio-economic pathway outlined by Priefer et al. (2017) (see table 5.1). Thus, for a proper verification of business operations' level of sustainability, a holistic, multidisciplinary consideration is needed. Hence, lack of methods for measuring sustainability was claimed as

something that potentially hinders the development of sustainability. One interviewee described the evaluation of a fiber-based packaging products' sustainability as follows:

> *"[…] when we use [bio]materials in some manufacturing, we cannot claim it to be undoubtedly a good thing, but there is a broader scale of preconditions that need to be fulfilled so that a product's whole life cycle can be evaluated whether it is sustainable and sensible" – Industry representative.*

Indeed, several conditions came up that according to the interviewees, which are required for the bioeconomy to be truly sustainable, as was also presented in the figure 5.1.

A specific sustainability feature that was mentioned the most often, was that the bioeconomy and the fiber-based packaging sector in particular, uses renewable materials in the manufacturing processes. The representative from research community mentioned the following interpretation about the subject:

> *"It is about economy that is based on renewable materials. Therefore, renewability is the main basis, which then depends on where we are because a renewable resource is different around the globe. And of course, in Scandinavia, for us it is forest bioeconomy." – Research representative.*

Many of the interviewees saw renewability as an answer to call of the issue of resource scarcity, which is considered a major global threat even under the bioeconomy era (see e.g. Pätäri et al. 2016). From company perspective, securing material supply by using recyclable materials and thus ensuring sufficiency of resources is a greater necessity for businesses in the future, as was expressed by the research representative. One industry representative stated the following about the importance of recourse scarcity:

> *"If we do not learn to live with the earth's capacity, things are going to end up badly for the future generations [...] for our society to be successful we have to deal with the resources that the earth is capable to produce. In that, the biological processes are in the very center." - Industry representative*

Here, sustainable forest management was considered important since forests are the lungs of the earth and the most important source of biomaterial especially in Finland. Therefore, the importance of sustainable forest management and uptake of forest certifications were highlighted as important cornerstones. According to the interviewees, material acquisition is an important factor to take into consideration when thinking about the core sustainability challenges in the bioeconomy. An industry interviewee highlighted this as follows:

> *"We can have a 'quick win' for the bioeconomy, but it needs to be truly sustainable"* - *Industry representative.*

There were also case that it was brought up that the use of renewable fiber-based materials does not automatically lead to more sustainability if we utilize forest resources without thinking about the long run effects. The use of forest certifications was seen as a competitive advantage for the wood-based materials compared to alternative bio based resources that do not yet have such certification systems.

Other ecological features that were commonly understood as being part of a well-functioning bioeconomy involve biodegradability, recyclability, sufficiency, environmentally friendly material and overall sustainability. Biodegradability and recyclability of materials were justified generally with global waste problems where recycling and biodegradable products reduce the amount of waste in the environment. With renewable materials, it is possible to improve resource sufficiency. Additionally, one industry representative saw micro plastics as an issue that might become more threatening in the future and as something that a broadening use of fiber-based packaging could solve. As a part solution for these sustainability challenges, the bioeconomy was considered as *"the right choice"* (Industry representative) for both the society and for the economy. Thus, this supports the statement that what was mentioned earlier in the results, that sustainably operating organizations would be successful in the future.

Additionally, developing solutions for end-of-life cycle of the packaging products came up in several interviews, as it was considered to highly influence the sustainability in the bio-based packaging related bioeconomy and thus needs to be carefully designed and implemented. Here, cascading use of biomaterial, material requirements especially in terms of increasing recycling rates were highlighted in the

interviews. Right way of recycling was acknowledged essential in the bioeconomy. It was often followed up with a claim that "the right decisions in the upstream bioeconomy, such as sustainable forest management, do not really help without a right recycling system in the end-of-life cycle". One industry representative mentioned following about the recycling:

> *"If the biomaterials end up in the landfills it is harmful for the climate change". – Industry representative.*

The question of whether fiber material should be recycled and reused or burned was often discussed as generally, recycling was often mentioned to be an optimal solution but not in every circumstance the wisest choice from the environmental perspective. This was argued by claiming that because the society will need energy any way it could as well burn some of the packaging materials and thus producing some energy. In addition, long transporting distances were seen as issues that sometimes make it less sustainable to implement recycling. It was generally considered a case-by-case issue as it is sometimes difficult to define the best decision for the environment. An industry representative explained this as follows:

> *"[…] often it is possible to recycle the material without a problem. Mostly it is about if it's possible to cost-efficiently and sensibly collect the [packaging] waste, so that the effect of collection and transportation is not more harmful for the environment than to not recycle at all" – Industry representative.*

The interviewees' general view was that the circular economy is a part of the bioeconomy or that the two must be working efficiently at the same time for the bioeconomy to be sustainable. An interviewee combined these sustainability factors as follows:

> *"I think that if the sustainability factors are taken care of, forests grow more than what is harvested and the bio based material is recycled properly we can call it sustainable development" – Industry representative.*

An industry representative expressed that location of manufacturing is crucial for the sustainability especially in the fiber-based packaging sector by stating the following:

"I think that more important is that everything that is produced, especially in the packaging industry, is produced near end-users or near industry that packs the product and after use, it is possible to be recycled near and re-produce materials" – Industry representative.

According to the same interviewee, the location of manufacturing strongly effects the carbon footprint of the packaging. Besides this comment, the interviewees usually did not include topics such as carbon footprint or carbon dioxide in the discussion about fiber-based packaging nor did they place any major stress to those topics. A research representative explained that in the packaging industry, the product itself has usually higher effect on carbon dioxide emissions than the packaging itself. Thus, the selection of attributes for packaging such as the material selection, are very important to keep the product safe and prevent an unnecessary loss of resources. According to the research representative, packaging's influence to carbon footprint is often greater than just the package itself. Therefore, it makes it more difficult to evaluate sustainability of packaging.

5.4 Resource utilization

In general, the exploitation of renewable resource in its operations was considered as one of most illustrative features for the bioeconomy. This was often followed up by a claim that the bioeconomy should aim at decreasing the use of non-renewable, fossil-based materials by replacing them with renewable alternatives.

The interviewees' opinions about which pathway the development of the bioeconomy in the fiber-based packaging sector should take, was found to differ across interviewees and no clear consensus could be found. From the two approaches, the socio-ecological one was highlighted slightly more frequently, emphasizing the implementation of a circular economy and thus reducing the absolute demand of recourses. Additionally, few interviewees considered technological approach with increased resource efficiency to be more important. However, the simultaneous development of these two paths was most often seen, as the optimal way of

development as presented in the table 5.2. Only a couple of interviewees were certain that the one is more important than the other. Representatives from the different stakeholder groups did not show notable profiles in their opinion.

Table 5.2. Summary of interviewees' opinions about the implementation pathways.

Elements	**Technology-Based Approach**	**Socio-ecological Approach**
Understanding of sustainability	- After enough contribution in optimizing company's operations and processes is made, sustainability becomes a more implicit factor	- Sustainability within the bioeconomy should not be taken for granted - Products whole life cycle has to be assessed to measure its effect on sustainability
Resource utilization	- Technological approach is more important approach in reacting to population growth and growing standard of living - Especially in the packaging sector, where plastics are cheap and easy to get, recourse scarcity is not a problem - *"In Finland, running out of trees is not a problem"*	- Customers' needs may depend on what a company has to offer (chicken or egg dilemma) - Recycling may face difficulties with more complicated products in the future
Consumer behavior	- So far, consumption habits have not changed much but companies have developed their operations and products to be more efficient and environmentally friendly - Potential for technological development to reinforce sustainability through better resource efficiency in manufacturing and better use of circular economy	- A shift towards more sustainable consumption habits potentially has a big impact on sustainable development - Today, sustainable consumption is a strong trend among the consumers - Potential influence of governmental regulations to consumer behavior
Innovation	- Small domestic markets do not provide enough demand in Finland to support competitive development - Problem of becoming only a material supplier and not a manufacturer of high value-added products	- Good and wide knowledge base in Finland supporting local value chains - High potential of bioeconomy innovations in Finland

One industry representative expressed that both of the development pathways are important. He highlighted that although no matter how efficiently the circular economy works fiber-based resources still have a technical limitation of around 4-6 recycling cycles. Thus, new raw material input is needed anyway and resource efficiency should be developed to the ultimate level. One industry representative claimed that so far, the issue of resource scarcity does not hugely concern fiber-based packaging sector and highlighted that this is the case especially in Finland, where forests grow more than what is harvested. The interviewee ironically commented about resource scarcity as follows:

> *"[…] as far as I know, [the amount of] resources is not a problem. […] I would like to see when we run out of forests in this country" – Industry representative.*

Additionally, the research community representative stated that *"in the packaging industry the recourse scarcity is not yet a big problem, as plastics are easy and cheap to get"*. However according to several bioeconomy strategies, the use of fibers should be increased overall to enable greater sustainability. Thus, the issue of resource scarcity should be discussed at the point before it creates problems in the form of market distortion.

In the industry stakeholder group, some interviewees had doubts that consumers' habits could not be influenced enough in order to develop a circular economy that would alone fulfill the future requirements of sustainable development. One industry representative highlighted that because of global population growth and aging there is too much pressure for socio-ecological approach to be the ultimate solution, thus he claimed that the weight would need to be put in technological development.

A popular discussion topic among the interviewees regarding the resource utilization, dealt with competition between different packaging materials. Materials that were generally discussed included glass, different metals, plastics, bioplastics and fiber-based packaging. All the interviewees had similar understandings about the main aspects of the future development of the materials. Figure 5.3 presents an evaluation of the main packaging materials according to the interview results. Colors that are used in the figure 5.3 indicate which of the attributes were perceived as a positive (green) or a negative (red) attribute or where the interviewees had mixed opinions (yellow).

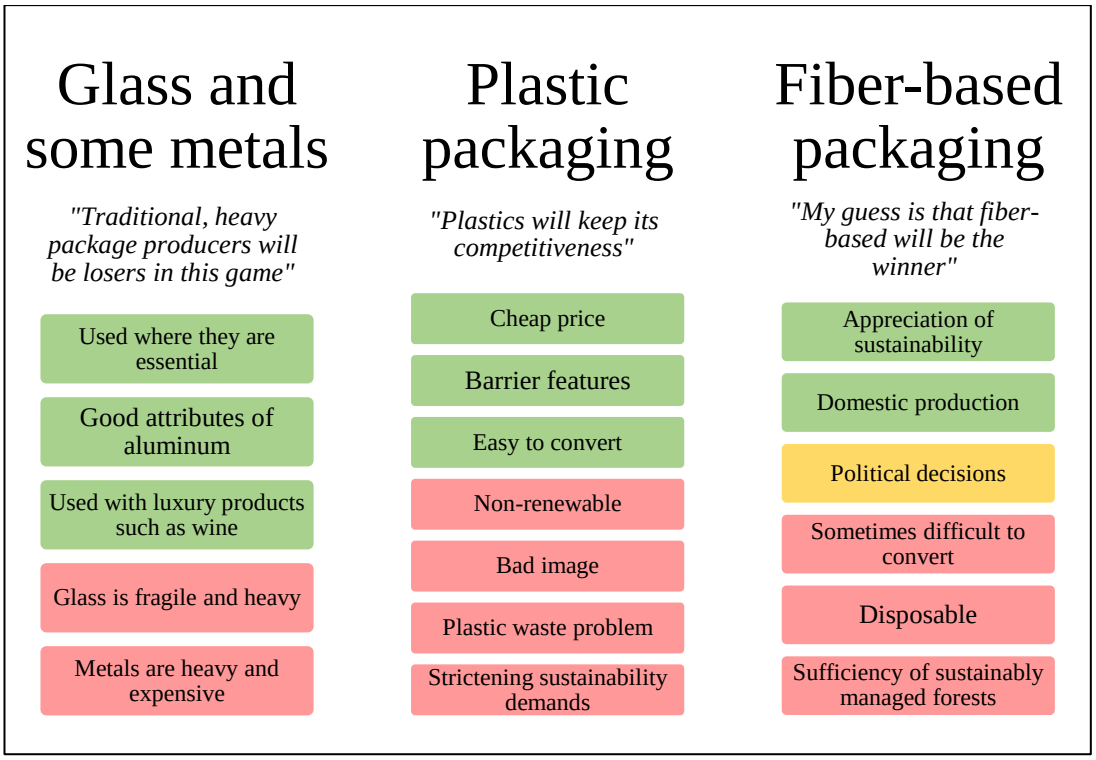

Figure 5.3. Evaluation of different packaging materials according to the interviews.

A general opinion among the whole study group was that fiber-based materials have overall the brightest future in the packaging sector. The interviewees identified that different trends are overall in favor of fiber-based packaging. Table 5.1 presents trends that occurred in the interviews that are either beneficial or threatening for the fiber-based packaging sector. These trends are divided based on the topicality across stakeholder groups according to the interviews, so using this approach the different number of interviewees in each stakeholder group need to be considered.

Table 5.1. Trends influencing the development of fiber-based packaging according to the interviewees.

Trends	Opportunities				Threats			
	Industry	Research	NGO	Government	Industry	Research	NGO	Government
Demographical factors								
Population growth	x	x						
Growing standard of living	x	x						
Local business	x			x				
A growing market	x			x				
Smaller packaging sizes	x			x				
Technological factors								
Rising ecommerce	x	x						
Smart packaging	x							
New business models		x						
New materials					x	x		
Manufacturing and material attributes								
Convertibility	x					x		
Plasticity					x			
Fiber-based materials are not the cheapest choice					x			
"Last printable media"	x							
Sustainability factors								
Fight against food waste	x		x					
Good image of fiber-based products	x	x	x	x				
Disposability					x		x	
Plastic waste problems	x							
Biodegradability	x							
Bad image of forest cuttings					x	x	x	x
Tightening competition for forest resources						x		
Ecological values become more appreciated	x	x	x	x				
Recycling					x	x	x	

A research representative saw that the fiber materials are the only materials that are bio based, recyclable, renewable and which can be sustainably transformed into bioenergy at the end of life cycle. Thus, fiber is considered to have *"all the right attributes"* (Research representative) to match with sustainability trends. An industry representative commented the following about the influencing trends:

> *"All big drivers strengthen fiber-based packaging's position. No such megatrend exist that weakens it. But surely, from a technic-economic perspective, everything should not be made of fibers if it's cheaper to use plastics." – Industry representative.*

Another industry representative mentioned that a comparison between production costs with materials can essentially restrain the broader use of fiber-based materials. Thus, the level of introducing new fiber-based products often stays at the *"marketing jargon level"* (Industry representative) when cheaper material and manufacturing combinations exist. Generally, the interviewees thought that the economic factors were so important, that the material choices would not change as rapidly as the technology often enables, as described by one industry interviewee:

> *"Already from the technical point of view, we could make a lot of things [from fiber-based materials] but it just does not make any sense to do those things yet" – Industry representative.*

As a potential downside, the interviewees saw the disposability of fiber-based packaging products as a possible negative factor. It was described as *"disposable culture" (NGO representative)* that might in the future be criticized as useless waste.

In addition, some industry interviewees and the government representative claimed that policy makers might and should reinforce the use of fiber-based packages. The interviewees mentioned that this could be done by adding environmental protection/recycling facility taxes for products that are not considered environmentally friendly. On the other hand, politicians' decisions are not considered as automatically leading to positive outcomes but these involve risks, which were also acknowledged as mentioned by an industry representative as follows:

> *"[…] political decisions hopefully will not affect the cost structures negatively by supporting someone and then being destructive for another.*

In political decisions, there are always drawbacks when somebody makes a decision in a good faith, which turns out to be a catastrophe for another" – Industry representative.

Some industry representatives additionally claimed that with difficulties to know when a new regulation emerges, it potentially makes an investment decision more difficult and delays their execution. In addition, often there is lack of perseverance in policymaking to ensure a stable operating environment for the (targeting mainly incumbent) companies and for the consumers was considered important.

According to most of the interviewees, a strong history of forestry in Finland depicts the whole conceptualization of bioeconomy in the country. Thus, in Finland the discussion about the use of resources in the bioeconomy strongly deals with the industrial oriented monoculture forest management, and the use of forests mainly as host of raw material. Additionally, an industry representative highlighted that the use of the concept and what it emphasizes varies depending of the user as described here:

"The understanding of the circular bioeconomy depends on what is the regrowth time of the biomaterial that you are using […] and about what the bioeconomy emphasizes, it depends on whether you are discussing from a policy, economy or an individual corporation point view." – Industry representative.

Additionally, fiber-based packaging's domestic production was considered a positive attribute by interviewees from various stakeholder groups. An NGO representative compared this to plastic industry as follows:

"[…] it [the origin of oil] has not been questioned that much yet" – NGO representative.

With the previous citation the interviewee compared origins of materials that are commonly used in packaging and praised the domesticity of most of the fibers that are used in the Finnish packaging sector. An industry representative described that the local manufacturing is benefitting in two ways. Firstly, it supports the domestic employment, which is overall considered a legitimate policy goal. Secondly, for

companies it provides flexibility, enables keeping smaller inventories, and cuts costs via faster inventory velocities improving their operations.

Because of the fiber-based packaging sector's seemingly bright future, the interviewees saw increasing level of competition after bio resources. Some of the new forest sector investments in Finland were pointed out to highlight urgency of the issue. According to a research representative, companies who can provide a sufficient stream of bio resources could create a competitive advantage in the future.

Regardless of the stakeholder group, the interviewees were uniform on the future, in which glass and some metals will continue to lose their share as packaging materials. Certain factors that affect the use of these materials were discussed. Firstly, glass and metals such as tin and steel are heavy, which creates additional costs, compared to lighter materials. Secondly, these materials, especially glass, are fragile. Additionally, they were considered overall to be more expensive than their rivalries. According to an industry representative, glass will probably have its more niche applications such as in better wines and hotel and restaurant activities. In addition, several interviewees from various stakeholder groups thought that for a metal, aluminum has brighter expectations for the future, because of its good recyclability and lightness.

Plastics' share of packaging materials was generally considered to remain stable towards the near future. According to the interviewees, plastics still have attributes that make these a competitive choice in the material selection. The low price was considered one of their main competitive advantages, in addition to easy and cheap convertibility as well as *"annoyingly good barrier features"* (Industry representative and research representative), which were seen as benefits for the choice of material in the packaging sector. Mutual downside for plastics future as a packaging material was considered to be its bad image in the eyes of environmentally conscious consumers, especially recently with a connection to global plastic waste problem mentioned by several interviewees. In addition, the interviewees' strong opinion was that non-renewable packaging materials would lose momentum to renewable alternatives in the long run. An industry representative expressed his thoughts as follows:

> *"I think it is clear that value chains in packaging industry that are based on non-renewable materials will lose this game" – Industry representative.*

However, according to the interviewees, plastic packaging industry will also aggressively respond to new market requirements, e.g. by developing new bio and recycled plastic packaging materials and by steering towards greater sustainability of their products. An industry representative commented this possibility as follows:

> *"But also, plastic sector has opportunities, they will introduce these recycled plastics and plant-based plastics and also use bio concepts and bioeconomy" -Industry representative.*

Several interviewees acknowledged that because bioplastics' attributes are unclear for e.g. consumers and some politicians their sustainability might be taken for granted. Concerns were raised mostly towards the terms bio based and biodegradable, which were considered to sometimes be mixed together. An industry representative claimed that a bioplastic can be either bio based or oil based and in both cases, it is possible to have biodegradable and non-biodegradable products. This complex setting raised concerns between the interviewees. One of them saw a possible problem in the issue if the bio based plastics would lead to a situation where plastic sector *"receives remission of sins" (industry representative)* without really being biodegradable. An industry representative described the problem as follows:

> *"It won't help in solving the plastic waste problem […] it [bio plastic] looks the same when it ends up in the ocean and in the nature"- Industry representative.*

Another industry representative mentioned that some actors drive their own agendas to use these bio-based terms incorrectly either by accident or on purpose. An interviewee mentioned that the terms and concepts are unclear for some consumers, as are multitude of sustainability labels. Thus, it appears that it can be possible to benefit from unclear meanings of terms, which can happen also in the fiber-based sector.

Additionally, the plastic packaging industry will develop its traditional products further. According to an industry representative, this may happen by generating better resource efficiency by developing packages that use less material.

5.5 Consumer behavior

Both the technological development and the perceived change in consumer behavior were found important to bridge resource gaps in the future. The pressures to change however differed as well as the issues that the interviewees grasped considering about the consumption topic.

Several interviewees from various stakeholder groups hoped for a change in consumer behavior. The industry representatives highlighted that consumers' recycling habits need to change and that the technological development is also important in bridging resource gaps in the future. The other stakeholder groups also generally claimed that technological development is important but additionally that influencing consumers' purchase choices is equally important. An industry representative expressed the recycling standpoint as follows:

> *"We need a change in consumer behavior for people to understand the importance of recycling. Because if we have a bio based product that ends up in a landfill it is end of game" – Industry representative.*

Following the same line of thinking, the interviewee explained that if recycling is not efficient and people do not use disposable goods such as paper cups anymore: *"then we would be out of business"* (Industry representative). One industry representative thought that with population growth only a change in consumer behavior would not have enough effect to prevent environmental threats from worsening. Thus, the society would need to develop our technologies to be more environmentally friendly and acceptable for the consumers. Another industry representative had similar thoughts about the bioeconomy's ability in involving consumers so far and he saw companies' role more in developing more sustainable products and manufacturing without affecting to consumers' choices greatly. Meaning, that consumers have not adapted much so far, but are rather buying new products with same functionalities, however being more sustainable than the old ones. Here, the efficient use of materials and environmentally friendly manufacturing solutions were highlighted.

Additionally, from the industry perspective, the issue of which of the two should change first was considered as the *"the chicken or the egg"* problem. Meaning that for a more sustainable product to sell it will need to have demand, but to have demand,

product's quality and price need to fill the consumers' willingness to buy. An industry representative expressed his opinion that to hasten this development policy makers could direct consumer behavior slowly, highlighting perseverance in their decisions.

The research community representative mentioned that when a new technology or product is introduced, consumers would adapt and thus change too:

> *"[…] usually when a technology is being introduced it affects consumer behavior somehow. But how much change is needed is more difficult to define." – Research representative.*

Instead, the government representative expressed that so far consumers are not at all involved in the Finnish bioeconomy, but unlike several industry representatives, she saw a lot of potential in developing sustainability by highlighting the potential of changing consumer behavior:

> *"I think that a change in consumer behavior could have a great impact […] consumers should more actively ask for attributes such as products' origin and for sustainable, bio based products." – Government representative.*

Additionally, the research community representative expressed similar opinion that so far, consumers with their actions are not yet involved in increasing sustainability in the bioeconomy, but to be successful, they should be.

The NGO representative explained that for food products, consumers generally considered packaging to be a greater disadvantage for the environment than manufacturing of groceries that it contains. A research representative stated that when a consumer unwraps the product the package instantly becomes garbage. Additionally, some interviewees wondered if consumers were truly willing to buy products with less durable or lasting packages instead with putting their money into products with greater sustainability. Such attribute that was mentioned was shorter shelf life of a product. An industry representative thought about this as follows:

> *"[…] consumers should be ready to accept bio based products that have those attributes that necessarily do not match with those traditional, highly natural recourse intensive applications" – Industry representative.*

On the other hand, because packaging protects its contents and can prevent e.g. food waste, one can consider that it is not a good place to try to achieve more sustainability. An NGO representative commented this view as follows:

> *"[...] sometimes consumers may not identify that it [a package] can be good although it is a little bit more consuming, because relatively, altogether it can be more environmentally friendly, if we can lower the food waste [...]" – NGO representative.*

The research representative claimed that typically a customer does not make a buying decision by comparing the sustainability of different packages, but rather the product inside. On the other hand, packaging was generally considered to create a first impression for the consumer and some interviewees considered it merely as a great marketing tool. As a summary of the NGO and research representative's opinions, the current situation is so that most of the consumers do not consider that packaging has any great influence on the overall sustainability. However, as the interviews revealed, more sustainable products were considered to be introduced in the future. The interviewees did not have critical comments about increasing the consumption in the future. However, for example smaller packaging sizes in the future were considered beneficial for the fiber-based packaging sector as it increases the number of packages that are sold. The industry representatives mostly discussed about current businesses and highlighted their ability to grow but did not emphasize new business models, which signals of reluctance or inability to create new businesses based on lower levels of consumption.

5.6 Innovation

From an innovation point of view, the interviewees considered both the technology based and socio-ecology based approaches to be important for the fiber-based packaging sector, and both were considered as equally important. Overall, the evaluation between the two approaches appeared to be difficult as the interviewees saw both approaches essential or even self-evident for fiber-based packaging sector.

Because of the close relationship between the two approaches, a complementary approach is needed for the fiber-based packaging sector's future development.

According to a research community representative, many types of innovations are needed for a real breakthrough to be achieved in the fiber-based packaging sector, highlighting a complementary approach by stating the following:

> *"Favoring social innovation and local value chains is important, but then also technological and business innovations are needed" – Research representative.*

Other stakeholders commented quite similarly, and one industry representative had following opinion about the topic:

> *"They both have their roles. Global value chains and global competitiveness are no doubt important drivers but it goes hand in hand with social innovations and local value chains […] Thus, they are both important […]" – Industry representative.*

Several interviewees from different stakeholder groups expressed that the Finnish fiber-based packaging sector is highly developed with a lot of technical expertise. Additionally, the knowledge on other fields such as chemistry, research and product development were thought to benefit the sector. Big Finnish forest companies that operate on fiber-based packaging sector are good examples of the country's expertise according to an industry representative who additionally thinks that the emerging bioeconomy suits well for a country like Finland, where local knowledge is high as he claimed the following:

> *"I think that the situation is very delightful for a Nordic country with not many inhabitants but a lot of forests like Finland where there is a lot of knowledge and technology, ability to adopt to the situation. Therefore, this situation is quite delightful" – Industry representative.*

With strong opinions among the interviewees about Finland's good level of competence, there is evidence that the socio-economic approach already has a strong support in the country. Still, additionally the opportunities for building more local value chains could be improved. A government and a research representative discussed about how sparse the value chains generally are in the Finnish fiber-based packaging

sector. According to these interviewees, local value chains should have more operators with more focused activities to increase efficiency. They claimed that today, companies in the sector are big covering a large share of a value chain. In addition, another research representative expressed that the service business sector might offer great opportunities for Finland in the field of packaging sector and the whole bioeconomy due to the high-developed knowledge base on the sector.

Although both pathways were considered important and discussed simultaneously, the interviewees had more to examples about socio-ecological approach than about technological approach. An NGO's explanation of technological approach's importance was quite similar with few others' who expressed their opinions about its opportunities:

> *"Because the ridiculously small Finnish markets will not have space for even one more cardboard factory. Thus it [technological approach] is very important to take care of the whole picture" – NGO representative.*

As one potential way of development for packaging industry was considered to be driven by intelligent/smart packaging and further customization of packaging. Here, the packaging was considered to be communicating with other smart devices such as smart phones thus creating more value for consumers. On the other hand, according to an NGO representative, the idea of smart packaging may face difficulties, especially in retail businesses. This was argued with a claim that the retailers would need to make huge investments to get smart packages to work and additionally because of refrigeration chains that are not working properly which would reveal a lot of lacking. The research community representative identified that there are innovations concerning packaging materials and innovations concerning packaging design. According to the interviewee, the focus is now more on the latter but additionally factors such as cost efficiency and environmental issues are constantly being developed.

Several interviewees from industry and research community saw that the future product innovations to lean towards hybrid packaging. An industry representative expressed that a hybrid packaging would mix together good features especially from fiber-based and plastic packaging where the plastic would also be bio based. Interviewees' considerations about the positive (green) and negative (red) attributes

that hybrid packaging entails are presented in the figure 5.4. A research representative claimed the following:

> *"But then of course a mix of these [fiber-based and plastic materials] may be the one with really big profits, who can practically mix best features of the two. I think that it is the biggest victory here." – Research representative.*

By being able to add more features in packaging, packages will have wider range of applications. Similarly, it means that packaging will become more complicated and thus also more expensive. However, when the production scale gets larger the prices will get lower as explained by an industry representative. In addition, according to a research representative, the hybrid packaging will make recycling more complicated as it is difficult to effectively separate different materials. The NGO representative supported this opinion and added that consumers generally prefer packages that are easy to recycle.

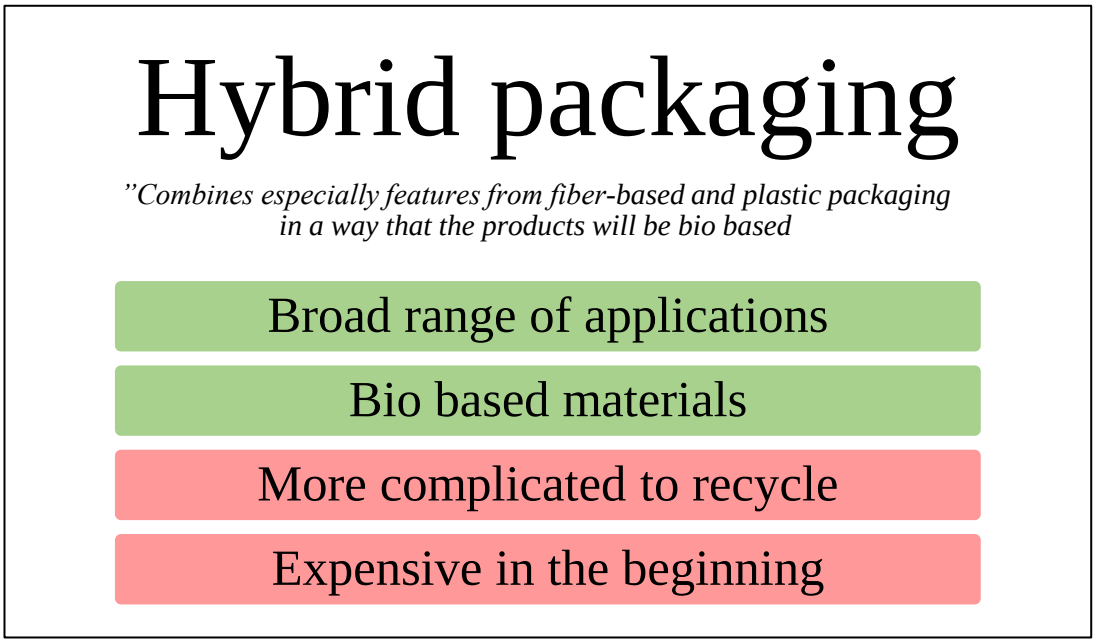

Figure 5.4. Hybrid packaging's features according to the interviewees.

6 Discussion and conclusions

In this study, a framework modified from Priefer et al. (2017) (see table 3.1) was used as a foundation of the interviews to examine how the network actors see the potential of the bioeconomy in the fiber-based packaging sector to evolve into the future. A general view was that for the bioeconomy to be successful it would probably need to integrate certain features from both, technological and socio-ecological pathways. Thus, a synchronous development of the two pathways was considered to lead to the optimal development as they benefit each other. From the four elements that were used in the analysis in this study, only "understanding of sustainability" was found to favor unanimously the socio-ecological approach. In rest of the elements, both of the approaches were found to be approximately equally popular. Additionally, a high number of interviewees spontaneously expressing that both of the pathways are needed, supports this conclusion. Opinions about the implementation pathways did not notably differ between the stakeholder groups.

Overall, measuring and verifying sustainability of packaging was considered a challenging task. The key sustainability attributes that have an effect on the sustainability of packaging according to the interviews are recyclability, renewability, locality, resource management, circularity, product protection and product safety (also in table 6.1). These attributes are widely spread around the life cycle of a package and often concern bringing together different actors throughout a package's life cycle.

Table 6.1. Summary of key sustainability attributes of fiber-based packaging according to the interviews.

Sustainable packaging	Product's end-of-life cycle
	Material renewability
	Locality
	Recourse management
	Introduction of circulareconomy to bioeconomy
	Protection of packaged product
	Product safety

Thus, this emphasizes that a holistic, whole life cycle assessment and life cycle assessment tools are needed to evaluate overall sustainability of operations in the packaging sector which is something that the interviews additionally suggested as the next step. At the same time, the interviewees voiced that several reasons exist for why it is difficult to always reliably consider every operations' overall sustainability, or environmental issues equally. Although the results suggest that evaluation of environmental sustainability performance of packaging is difficult to implement, various life cycle assessment based systems have already existed for a while that are designed for assessing different packaging materials and making e.g. packaging recycling more efficient and environmentally advantageous. For example, the green dot, which is a symbol used in many European countries (where in some it is mandatory) was announced already in 1993. It is used to signify that a financial contribution has been paid to a national packaging recovery organization for each piece of packaging (Germany, Garbage, and the Green Dot 1994). However, the interviewees barely mentioned such systems.

In addition, an industry representative claimed that this uncertainty and obscureness of different sustainability concepts, such as bioeconomy, enable their misuse, which might increase the overall skepticism towards the concept as according to the results is already apparent among the industry stakeholder group.

As a response to the research question about the conceptualization of the bioeconomy, the results of the study based on fiber-based packaging sector stakeholder interviews indicate that the concept of bioeconomy has a broad definition, which can be examined from various perspectives. In addition, because each interviewee could define the concept rather similarly on a general level, there evidently appears at the surface level a high level of acceptability for bioeconomy in the fiber-based packaging sector in Finland. However, after the discussions deepened and the interview topics became more specific, the interviewees' understandings and opinions started to diverge especially not only within the industry stakeholders, but also between industry stakeholders and the rest of the sample. This implies that the bioeconomy concept could benefit from further clarification, which would improve its future viability in communicating strategic goals. Furthermore, a need for improving the understanding of the bioeconomy concept's sustainability aspirations was identified.

Based on interviews of this study, the concept of bioeconomy appears to be something positive for everyone and can be perceived as "a bridging concept", as also suggested by Hodge (2017). Research, NGO and government stakeholder groups' mutual and positive views about the bioeconomy being "a future economy" refers to a broad acceptance of the concept from their part. However, industry representatives' evaluations divided about the concept being truly a future economy or just a new marketing term that aims to broaden the industry's scope, which was found to be somewhat contradictive. Thus, due to some of the industry group members' skepticism, the concept cannot be considered as unanimously broadly accepted or mutually understood by all of the industry representatives. It should also be noted that this study had an intentional emphasis on the industry stakeholders due to specific focus on fiber-based business, which group was found to have the most variation in opinions.

Although a general view of the interviewees was that the bioeconomy has strong economic motivations, they also identified sustainable development as an important driver behind the increasing use of the concept. In packaging sector, the interviewees considered fiber-based packaging to be overall the most sustainable material choice, and that there will be a solid business case for sustainability in the future. However, renewable fiber was not considered self-evidently sustainable choice of material but sustainability needs to be properly executed, to in reality have a positive effect meeting on overall sustainable development goals. Additionally, some interviewees considered that, due to ecological reasons, it is not always the best choice to use fiber-based materials despite that it was technologically and economically a viable option. Although the interviewees unanimously saw that fiber-based materials should be more widely used in packaging; still it seemed to be widely unclear to what extent fiber should replace other materials from an environmental perspective.

A broad sustainability question of how much packaging is overall necessary globally was not discussed and for example, over-packaging was not mentioned in the interviews although fiber-based packages are the main packaging waste that was generated in 2014 (Eurostat, 2017). However, the interviewees thought that without proper considerations and life cycle assessments, fiber-based materials could be used in applications where they do not increase the level of sustainability. Additionally, the importance of including circularity in the bioeconomy was acknowledged by many of

the interviewees. With overall a strong focus on sustainable development among the interviewees, the first criteria of "sustainable use of natural recourses" by the Nordic Council of Ministers (2017) is evidently taken into account by the interviewees.

Even though some of the stakeholder groups were highlighted to be more important for the evolution of the bioeconomy, the interviewees broadly mentioned stakeholder groups across the whole value-chain in the fiber-based packaging sector and highlighted their significance so that it became obvious that a uniform acceptance is needed to drive the bioeconomy forwards. Thus, this supports the results of some studies (see e.g. Pfau 2014; Hageman 2015) that all of the stakeholders need to be heard in the discussion and take into consideration for the future development of the bioeconomy. One group that was regularly mentioned of being the most important in the bioeconomy's development, the brand owners, were not interviewed in this research.

Brand owners importance is supported by several studies (see e.g. Hess et al. 2014; Chen et al. 2017) that emphasize that packaging serves a critical role in a company's marketing and in building a sustainable brand image. In addition, because the bioeconomy is often labelled as a branding or a marketing term, learning more about brand owners' views about the concept's development could be rewarding and a possible topic for future studies. More precisely, as Chen (2008) summarizes the debate in the field of environmental management by asking whether sustainability should be corporate social responsibility or corporate social responsiveness, a future study could assess Finnish or global brand owners' level of own initiatives and to which direction the packages are being developed in the future. In other words, on what level and which direction are brand owners themselves pushing and thus mediating to the development of the bioeconomy.

In addition, brand owners' inclusion to the discussion about the bioeconomy's development in the fiber-based packaging sector would be interesting and justified as some interviewees presented the issue of presenting new packaging products to be a chicken or egg dilemma (as described in the chapter 5.5), which highly affects the development of the bioeconomy in the fiber-based packaging sector. Brand owners were additionally mentioned when the industry representatives expressed that they set the requirements for the packages, and the industry's task is to fulfill their needs. Thus,

they evidently have an effect on the direction where the future packaging solutions are being developed and the role of the brand owners could be better incorporated in the future research when assessing the future prospects of the fiber-based packaging. Additionally, due to the threat regarding the misleading use of sustainability related concepts that were also mentioned by the interviewees in this study, open discussion and open inclusion of stakeholders in the discussion about the future development of the bioeconomy is necessary. For example, various researches exist that focus on studying business model innovations regarding ecological sustainability from theoretical, business model analysis point of view (see e.g. Carayannis et al. 2015; Bocken et al. 2013).

The industry representatives often highlighted the importance of recycling, but simultaneously discussed the consequences of replacing disposable packages with reusable solutions. An example about this kind of a development is the "latte levy"-case (The UK House of Commons Environmental Audit Committee in 2017), where the government in Great Britain considers adding a tax for disposable cups thus favoring the use of reusable cups. In this study, an industry representative expressed that if the consumers would choose reusable cups instead of disposable cups, assuming there are not fiber-based reusable cups available, the company would be "out of business". Thus, it was generally considered that the concept of circular economy should be merged together with the bioeconomy to enable the most sustainable solution for economy. In the interviews, an industry representative used an expression of *"circular bioeconomy"* to emphasize the claim about their alliance.

The level of companies' own initiatives for achieving sustainability, such as investments to research and environmentally friendly manufacturing is something that was not studied, but would have enabled some interesting insights. However, technological innovations were considered to be very important also in packaging sector. Thus, the interviewees can be considered to be aware of the features in the Nordic Council of Ministers (2017) second criteria of "technology development". Innovations that were discussed include developed resource efficiency including broader introduction of circular economy and material innovations. Discussions about innovations with the interviewees was also often linked to the third criterion "environmental benefits" developed by the Nordic Council of Ministers (2017) as they were able to notice potential innovation paths and their effects on sustainability in the

packaging industry. Bioplastics and hybrid-packaging were considered to have a strong place in the future of packaging. However, the interviewees often mentioned that especially bioplastics, if not biodegradable, are not necessarily much better choice for the environment than plastics. Both research and industry representatives stressed that it is important to identify what bioplastics' different features stand for. The interviewees claimed that there is a threat that consumers start taking the sustainability of bio-based plastics for granted.

One industry representative and other stakeholder groups unanimously and spontaneously mentioned that the benefit of using the bioeconomy concept is in linking different actors and sectors together. This was argued by lowering the "silo-effect" within the fiber-based packaging sector and making interfaces between different sectors more efficient. These findings are closely similar to the research by Hodge (2017) who studied the understanding of the bioeconomy in the Swedish forest sector. His findings suggest that the bioeconomy is generally seen as a positive concept with strong bridging capabilities among the stakeholders in the Swedish forest sector. In addition, in his study, a broader acceptance for the bioeconomy was found. However, the studies cannot be compared together without considering about the differences between their realizations. In this study, the scope focuses on the Finnish fiber-based packaging sector, while Hodge (2017) studied the Swedish forest sector as a whole. Additionally, the distribution of stakeholders in his study did not stress the industry group where in this study, the acceptance was found to be the most controversial, but the representatives were equally distributed. Additionally, in the Swedish study, forest owners were interviewed instead of research representatives.

The bioeconomy can be viewed to contribute toward gaining societal benefits (Nordic Council of Ministers 2017) if it succeeds in reducing silo-effect between sectors and bringing stakeholders closer to each other in the fiber-based packaging sector. However, the discussion about the societal benefits beyond these aspects were not discussed. For example, bioeconomy's potential in providing jobs was not mentioned by the interviewees. Bioeconomy's potential in closing the gaps between various stakeholders and sectors was claimed to create more possibilities for new "business model innovation", which is the fifth criterion in the framework for managing the transition to greener economy by the Nordic Council of Ministers (2017). Investment in production facilities and research and development were perceived important for

the future success. Based on the responses by the industry and research representatives, it was clear that companies aim for creating new high value-added products and that the threat of becoming only a material supplier need to be avoided if the brand owners and consumers are located outside of Finland or Europe. A research representative additionally mentioned that also in the fiber-based packaging sector, service related innovations contain great opportunities, as also concluded by Olsmats and Kaivo-oja (2014).

Because the interviews provided rich amount of relevant data, the developed questionnaire and targeted sample can be claimed to have worked well. Openness of the explanations enabled different interpretation of some of the questions and therefore the interviewees could sometimes answer to the questions with different ideas. Although the interviewer tried to minimize these differences by directing the interviews, on a couple of occasion discussion about some of the elements remained too vague and could not be incorporated in the results. Furthermore, table 3.1 was not always assessed as profoundly as the interviewer would have preferred.

Another limiting part in the thesis was some of the interviewees' apparent underpinnings of own and organization's interests. This sometimes led to discussions that remained on a superficial level where positive and progressive words were used but no concrete issues regarding e.g. the downside of the fiber-based packaging was discussed, such as over packaging and packaging waste.

When selecting interviewees for this study it was found challenging to find suitable NGO representatives with sufficient knowledge from the packaging sector. However, the few that were found can be considered as serving the study's objectives well by expressing their perspective about the concept of bioeconomy. For other stakeholder groups, the interviewees were found to be easier to find.

In using the conceptual model from Mikkilä (2003) this study recognizes that the changing nature of values is both a strength and a weakness of the model of acceptance. Thus, by assessing stakeholders' understanding and acceptance of the bioeconomy, this research is bound in time and describes the current situation in the fiber-based packaging sector. Therefore it remains a task for future studies to update and broaden the empirical scope to other bioeconomy products and regions of sustainable production and consumption.

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